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MAY 28, 1887.

THE AMERICAN ARCHITECT AND BUILDING NEWS

VOL. XXI. REGULAR EDITION NO. 596.

ARCHITECTVRE

ENGINEERING

DECORATION

CONSTRVCTION

TICKNOR & COMPANY

BOSTON, MASS.

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Venice by Day.
House at Minneapolis, Minn.
Houses, Cleveland, Ohio.
Shooting-Box, at Tuxedo Park, N. Y.
Banking-Room, Bank of Minnesota, St Paul, Minn.

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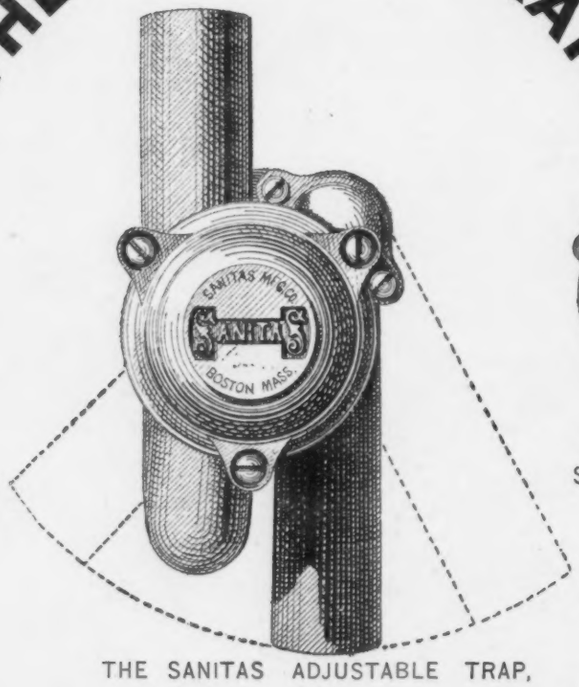

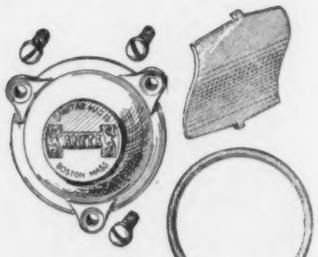

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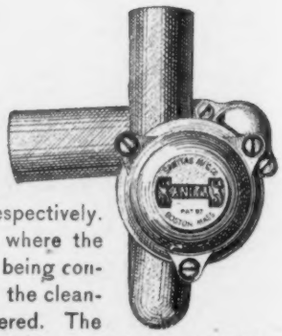

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MAY 28, 1887.

Entered at the Post-Office at Boston as second-class matter.

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THE telegraph brings the news of the death of Mr. Horace Jones, the architect to the City of London, and a man of very considerable note in the profession. He was sixty-eight years old at the time of his death, and had held his appointment for many years. As with most architects in official positions, where they can do more good by judicious advice than by startling novelties in design, his professional work was distinguished for quiet respectability rather than originality, and some years ago, when he was a candidate for the Presidency of the Royal Institute of British Architects, in opposition, we believe, to the late George Edmund Street, the point of his lack of distinction as an artist was constantly brought up against him. Notwithstanding this, he was elected, and administered the office with a gentle dignity, which won him universal esteem, and his fellow-members will sincerely regret his loss. Since his retirement from the presidency of the Institute, his best-known work has been the design for the Tower drawbridge across the Thames, which he devised in connection with a distinguished engineer. The engineer was probably responsible for the plan of a double roadway, one to be above the reach of ships' masts, for use in crossing while the main bridge was opened for the passage of vessels, but the architectural treatment of the problem, which was certainly not an easy one, must have been the work of Mr. Jones, and it was certainly successful enough to do credit to any architect in England, and attracted much attention on the Continent and in this country.

THE people who claim to have become convinced, through some process of reasoning peculiar to themselves, that labor organizations and strikes are useful to working people, rarely pay any attention to facts or statistics, or the report of the present condition of the iron trade in England would interest them. Every one has seen or heard of Wolverhampton, the once prosperous centre of the English "Black Country," whose coal and iron brought comfort and wealth to many thousands of the more or less thrifty people who inhabited it. Twenty years ago there were, within three of the towns, forty-seven smelting-furnaces in blast. There is now but one, and the owner of that, a man who has been in the business for nearly fifty years, and has paid out in wages not far from ten million dollars, is about to abandon it. There is no change in the natural conditions. The owner of the furnace also owns mines, which, as he says, would furnish material to carry on the works for fifty years longer, but the miners, by combinations and terrorism, have succeeded in establishing an eight-hour day; and as they cannot, or will not, in eight hours a day dig out enough ore for him to enable him, after converting it into iron, to sell it for what it costs him, he has concluded to put a stop to what, he says, "was once a profitable business, but is now a heavily-losing one." With his abandonment of his mines and furnaces, the five hundred men, with their wives and children, who have been living on the wages which he paid them, will be turned adrift on the world, many of them to become a burden on public charity. If they had wished, or, we might say, if they had had loyalty and sense of honor enough, to do faithfully the work which he employed them to do, both they and he would be in the full enjoyment of present prosperity and confidence in the future; but they chose to listen to the gospel of shirking and disloyalty so industriously preached by loquacious adventurers, and reap the fruits of the successful reduction of their doctrines to practice. In their case no hope remains. While carpenters, masons and mechanics can usually get work of a certain sort after cutting themselves off from regular employment, a miner or an iron-worker is helpless. Probably Mr. Sparrow, in consideration of their necessities, would willingly allow his men to extract ore from his mines, and try to smelt it and sell it on their own account; but the mines are filled with water, and must be pumped out before any ore can be dug from them. He has no more money to sink in the business, and they have none to hire pumps with; and no one, knowing their peculiar view of fidelity to obligations, would trust them with any, so they would have to remain idle, even if their late employer should make them a gift of his property.

MR. AITCHISON, who now holds the rather peculiar position of Professor of Architecture at the Royal Academy, succeeding the late Mr. Street, recently read before the London Architectural Association a clever paper on the education of architects, many parts of which are worth remembering. All architects will appreciate thoroughly the sentence in which the substance of the discourse was summed up. "It is the fashion," said the lecturer, "to talk of architecture as if it were a very easy and simple art, so that unless a man is equipped with many other things besides architecture, he has not much to boast of, as Ben Jonson says of the cook, 'He is an architect, an engineer, a mathematician, a philosopher.'" It might be due to his own incapacity, said the lecturer, that he had never been able to agree with this view. He had had his attention called sufficiently often to the examples of Vitruvius, Orcagna, Brunellischi, Alberti, da Vinci, Michael Angelo and Wren, who are not only architects, but poets, sculptors, mathematicians, and so on, but these examples only suggested to him that there were now and then in the world men of such rare genius that they could do two things well instead of one, and feeling himself to be a person destitute of genius, he was the more convinced that the best and safest way for him was to try to learn only one thing, but learn that thoroughly. The nature of the thing which he, like ordinary aspirants for success in architecture, ought to study he conceived to be indicated by the experience of mature professional life. So far as his observation went, a practising architect was expected to know how to build what his clients wanted, and to make the structure convenient, strong and beautiful, without excessive expense, and if he knew this, he was rarely called upon to display any acquaintance with other arts or sciences. Something, it is true, was desirable in the way of accomplishments, to enable an architect, like any other professional man, to mix pleasantly in society, and a young architect, to make himself agreeable to his clients, if he should have occasion to visit them, might well know how to dance and play lawn-tennis, just as an older one should be able to talk entertainingly and take an intelligent interest in whist or rural sports; but notwithstanding the common idea of architectural education, he had never known a professional man's prospects seriously injured by an inability to recall the names of the principal mediæval architects, or to read at sight a Greek play. There was, to say the least, good reason to believe that the mediæval and Saracenic architects could not have told who designed the Parthenon, but they were perfectly and thoroughly familiar with the materials which they used, and with certain empirical science of construction, and this knowledge did for them what our multiplied branches of instruction do not do for us.

IT is curious to find Mr. Aitchison, who has a high reputation as a decorator, and an architect of rather poetical genius, asserting, as he does in the course of the paper, that "practical geometry, stereotomy and stone-cutting are shamefully neglected among English architects;" and he goes on to say that "all the great architecture of the world has had geometry for its basis, and little that is great and good will reappear until architecture has been again based upon it." As compared with the mediævals, the best constructors that the world has ever seen, we have a great advantage in the possession of simple and sure methods of determining strains and resistances

of materials, but this advantage is much more than counterbalanced by their infinite superiority in practical experience, and close observation of materials, and the inventiveness and daring in construction which such knowledge inspires. If we are to emulate their success, we must follow their methods in the modern way. "Every man preparing to be an architect should be able to solve the statical problems of how thick an isolated wall should be in proportion to its height, to resist a given thrust; the formulas for the resistance of uprights to a load, with the coefficients for brick, stone, iron and timber; the pressure of water against the sides of a tank; the thrusts of arches, vaults and domes, and the determination of strains and resistances in girders and roofs." The architect, said the lecturer, must know also the qualities of the principal materials, and the proper modes of putting them together; besides the principles of healthfulness in buildings, and the means of securing it; the substance of the common and the statute law in relation to buildings and contracts; and he should make a careful study of planning, and have thorough and systematic practice in design. In his opinion the study of styles in design should be made more a means of analyzing the methods by which certain effects were obtained than as an exercise for the memory; and he would, in proposing a problem in design, avoid specifying that it must be in a given style, and say instead that the building must have an imposing, or graceful, or threatening character, as the case might be. This last suggestion strikes us as being a valuable one. We ought not to forget that except as a means of expression, architecture has no claim to be regarded as an art, yet the systematic study of architectural expression, as shown in actual examples, has hardly been thought of in our schools. Perhaps, if well managed, such an investigation might help more than anything else in the solution of that vexed problem, the creation of a modern style. Mr. Aitchison well says that the "isolated and divergent energy" of the profession might be applied much more effectively to the furtherance of art by greater unanimity in the choice of a type; and nothing would do more to facilitate the choice than a clearer understanding among students and architects of the sources of those impressions of breadth, unity and proportion which are independent of style, and in comparison with which the details devised by classic or mediæval taste are of small importance.

THE ever-interesting *La Semaine des Constructeurs* contains an article on a new announcement, of importance to architects, which has been made by the French Minister of Public Instruction, and which recalls, in a manner very unusual in France, the ignorant arrogance with which English functionaries sometimes see fit to deal with professional men. M. Berthelot addresses his circular to prefects and officials generally who may have to look after the construction of public buildings, especially of school-houses, which are the buildings which come particularly within his province, and notifies them that he will have nothing more to do with any requests for authorization to spend public money on any extras whatever in connection with a contract duly approved. Like most other people who know nothing of the subject, the Minister imagines that extras on a contract are generally ordered in some way for the benefit of the architect, and he formally warns them that in future the engagements of architects to conduct public work over which he has control will contain a clause by which the architect "expressly agrees that on his personal responsibility the cost of the work shall not exceed the limit named in the contract." M. Rivoalen, who writes the article commenting on the circular, speaks much more respectfully of this ridiculous clause than we are disposed to do, but he points out with sufficient force that in at least nine cases out of every ten, extras on contracts for public works of the sort are ordered or suggested, not by the architect, but by the mayor or other official superior of the architect, who, as he says, wakes up every morning, while the building is going on, with a new idea, which he wishes to see realized forthwith. If the architect resists, saying that this is not in the contract, and that he is personally responsible for extras, the official is offended, and immediately puts in force another stipulation of M. Berthelot's circular, which reserves to the administration the "absolute right" of dismissing the architect at any moment, and installs some new candidate, who proceeds to carry out his predecessor's design as he thinks fit. Even if an earthquake should occur, or a quicksand should be discovered in the cellar, or if during the years that elapse before a project for a public building gets through the Circumlocution Office to final approval, prices should have changed, the architect, according to M. Berthelot's circular, is equally bound to pay the difference between the cost of the executed building and the estimates out of his own pocket, provided he should have succeeded in dodging the inspirations of the mayor long enough to arrive at the end of his work.

IT is hardly necessary to say that no architects, except those who have nothing to lose, or those skilled in the practices by which all public work is made to yield a profit, will concern themselves with M. Berthelot's buildings until the circular is withdrawn or changed, although it is, to our mind, impossible of judicial enforcement. As M. Rivoalen points out, by the common law a professional man whose employment, as is stipulated in one clause of the circular, may be terminated at the pleasure of his employer, is not a free agent, but the servant of the employer, and cannot be held, even by contract, to any responsibility whatever for his acts in the fulfilment of his service, beyond the liability to dismissal if his work is unsatisfactory; and if, as a very eminent judge once said, "it would be monstrous to expect a lawyer to know all the law," it is still more preposterous to expect an architect to foresee every one of the myriads of items which go to make up a building; so that an architect who had not been expressly warned beforehand could not be forced to sign a clause assuming the risk of all contingencies; and, if he had been engaged, for instance, in pursuance of the terms of an ordinary competition, he might demand and recover his full fees in case the other party refused to allow him to carry out his work without signing it; but no architect can spend his days in ascertaining the law, and the margin of profit in professional work is far too small to make it worth while to accept commissions with the risk of an acrimonious suit attached to them. For the benefit of the tax-payers of the French communes, however, upon whom the effect of this precious circular will fall far more heavily than on the profession of architecture, we will point out how it is likely to increase their burdens. It is hardly necessary to say that he who takes risks, or guarantees what he knows nothing about, does not do so without intending to be liberally paid for his trouble, either directly or indirectly. The impecunious or unscrupulous architect who professes to be willing to give such guaranties as M. Berthelot demands is usually quite astute enough to deal with them. His first expedient is to come to an understanding with the builder, either privately or publicly, by which the latter relieves him of responsibility. We once saw a contract for an important public building, which wound up by saying that "this contract is intended to be for the building aforesaid complete in every particular; and everything necessary to make it entirely perfect is to be done by the contractor, whether anything is said about it in the plans and specifications or not." With such a contract as this it is hard to see how the architect could suffer; and under M. Berthelot's circular such contracts would be sure to be made; but any man of sense can judge whether they would be economical for the owner. A ten, fifteen or twenty per cent margin for contingencies is much more easily added to the builders' price than to the architects' fees; and while a faithful architect would hold even a contractor who had relieved him of responsibility to his agreement, there would be a strong temptation to both, if the mayor's inspirations proved uncontrollable, to make up for the unexpected additional expenses which he caused them by economy in places where the saving would be unobserved; and most architects, being human, would be disposed to provide, of course at the expense of the owner, a reservoir of this kind, to be drawn upon in case of need, for the protection of their own lean pockets, if not of those of the builder.

ACCORDING to a Hungarian paper, the longest tunnel in the world is one constructed many years ago in the mines of Schemnitz, a little town of North Hungary. Many of the mines belong to the Crown, and all these are connected together by subterranean passages; while a vast adit, ten feet wide and twelve high, runs below the mines, draining them all, and extending to an outfall in the valley of Gran, ten and one-quarter miles away. The Saint-Gothard Tunnel is a little more than nine miles long, so that the splendid work at Schemnitz, which is so graded that it can be used for railway trains, considerably surpasses it in length. The total cost was about five million dollars; but it is estimated that the saving in expense of pumping alone, which is secured by means of it, amounts to one and one-half per cent on the cost, independent of its use for giving direct and convenient access to the mines.

THE MORSE COLLECTION OF JAPANESE POTTERY.

Ancient Pottery.

THERE is a peculiar fitness in the fact that the largest, most valuable and complete collection of Japanese pottery in the world should be found in the quiet old city of Salem — of American places the richest in its associations with the Orient. One pleasant autumn evening in 1886 the writer stepped into the handsome Salem post-office — a new, but not modern-looking building, in the quaint Colonial style that best indicates the character of the historic city. Upon the black-board bulletin was chalked a notice that the mail for China and India would close upon a certain date. A singular notice for the post-office of a provincial New England city, it seemed, but in this place it carried a touching sentiment in its suggestiveness. The great East India trade, upon which the wealth and commercial renown of Salem were founded, has long since vanished. But in these few lines, chalked down as a matter of general public interest, the persistence of an old habit was illustrated. Slow indeed, if not comparatively infrequent, must have been the postal-communication with the East in the days when the mails carried from the counting-rooms of old Salem magnates voluminous correspondence with their numerous Oriental connections. Few business letters are probably now exchanged between these remote quarters, once so intimate, but perhaps the writing of this bulletin means the continued existence of those stronger associations of friendship which business relations are often the means of establishing, maintaining the ties of the soul long after the lines laid down by material interests have been broken. Therefore we may be allowed to picture some silver-haired, retired merchant, whose house is filled with rare old porcelain and delicate-textured and rich-hued Oriental stuffs — abundant treasures of which are to be found in many a mansion in the city — impelled still to write to old-time friends who linger in the East; English merchants, it may be, or perhaps some Mandarin or Brahmin with whom circumstances may have cast down prejudices and barriers of race and rank, and brought into mutual recognition those communities of mind and soul common to all humanity, and which, when recognized, make men brothers, however birth, training, or intervening lands or seas may have separated them.

The proud Oriental commerce of Salem has, perhaps, had a loftier significance, and in influence may be perpetuated in deeper and more subtile effects than has been dreamed. It created the wealth which exists in the community to-day, and which is the basis of much of its culture. The trade of the old town, reaching out into many remote parts of the world, carried the interest of the people outside of themselves, their own narrow range of actions and events, into the doings and happenings of manifold other nations and races. The scientific eminence which Salem has attained doubtless largely owes its existence to the alertness of interest and breadth of mind thus awakened. Its commercial period having passed and served its purpose, and the place having become a quiet, refined and intellectual community — though still industrious, growing, and prosperous — perhaps the mission of Salem, the pioneer settlement of the Puritans on Massachusetts Bay, may be as a scientific centre, already of no mean eminence, to convey to America many of the lessons to be learned from the varying aspects of human life in all parts of the world. These aspects are illustrated in the unique East India Marine Museum, the visible sign and heritage of the past commercial glories, and the creation and pride of the old-time ship-captains and merchants; in the incomparable Morse collection of Japanese pottery; and in other institutions centering there.

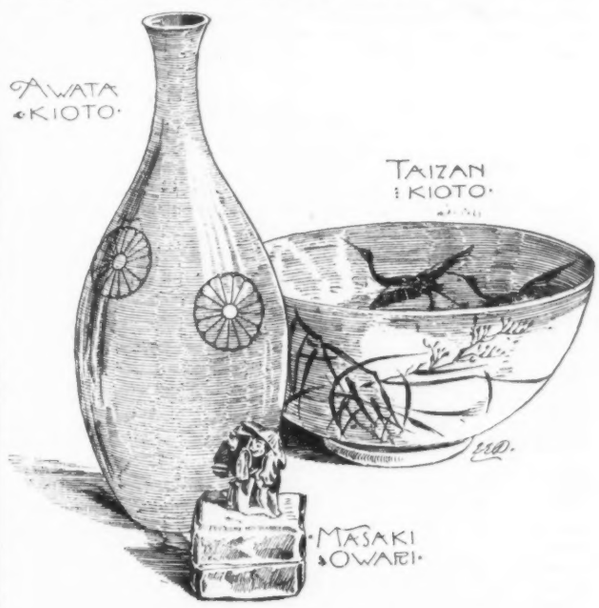
In the days of Salem's Oriental commerce there was, to be sure, little doing with Japan, which was self-sealed against intercourse with the Western world. Salem's connections were mainly with China, India, and the Spice Islands. But now that Japan has since developed itself as the most progressive nation of the East, rapidly changing its manners and ideas into accord with Occidental institutions, there is a poetical appropriateness in the fact that Salem should possess, in the shape of the Morse collection, an after-math from the old field; a token of things as they existed in her day in a quarter then unexplored, and where those conditions are now rapidly changing. As Salem herself has contributed towards the Renaissance of Japan, for the Imperial University the services of two of her best minds in the persons of Professors Morse and Fenollosa, it is well that this return should have come to her.

The collection, as it exists to-day, is to be found in the house of its owner and gatherer, Prof. Edward S. Morse, Director of the Peabody Academy of Science, The main portion of it is contained in a pleasant gallery, built expressly for its accommodation. The size of this apartment is eighteen by thirty feet. The rest of the collection, less interesting to the visitor, but essential to its completeness, occupies a room of the same size in the basement, directly below.

The main room is a charming place, fitted up in quiet harmony with the character of its precious contents. It is used by Professor Morse as his daily study, and he thus lives in continual intimacy with his collection. One who has seen something of the fascinating character thereof may appreciate how it must have, in this way, grown into the life of him who has called it into existence.

The neutral gray tint of the walls gives a reposeful relief to the rich, but unshowy contents of the shelves, which occupy something like three-fifths the height of the room. On the east side is an attractive brick fire-place; the shelves run entirely around the room, with the exception of this space and that of the adjacent entrance, the two windows in the opposite wall, and the large window on the north, beneath which Professor Morse has his writing table. On the wall there hang a few Japanese pictures, the most attractive of which, and particularly interesting and instructive in this connection, is a long, panoramic water-color of a pottery, illustrative of the entire process of manufacture. It is the work of Bairai, a Japanese artist, author of a number of art works and a famous teacher of drawing in Kioto.

Key-note of the Collection.



Wine Bottle, Bowl and Incense-box.
[The bowl shows how the design on the inside is part of design on the outside.]

It should be borne in mind that this is a collection of *pottery* only. Professor Morse first became interested in the subject through the study of the prehistoric pottery of Japan as a part of the researches instituted through his discovery and examination of the Omori shell-mounds near Tokio. The remains of primitive pottery found in these mounds necessitated a comparison with the prehistoric pottery of the country, and that, of course, led to further comparisons with the pottery, ancient and modern, of the present race; the prehistoric evidently having been the work of quite another people than the Japanese of to-day, who are not the aborigines of the country.

Furthermore, Professor Morse had felt obliged to seek some form of recreation as a diversion from arduous duties as professor of zoölogy at the Imperial University, and this ceramic study opportunely offered a pursuit most congenial to him. He soon perceived the remarkable opportunities of the rich field upon which he had casually entered, and he devoted his leisure time to it with characteristic ardor, bringing to bear the methods of a trained scientist. With the increase of his collection he was early impressed with the fact that the older forms, and even those pieces made within twenty years, differed in character from those made to-day. The recent work, with some important exceptions, showed unmistakably the influences of foreign intercourse. He observed still further that in many cases the old ways were very rapidly yielding to the new, and that, as a consequence of the rapidly-increasing use of porcelain, large numbers of provincial potteries were extinct, or dying out. This led him to expand the scope of his work far beyond the modest limits which he had assigned when he took it up, and he resolved, before it was too late, to make an exhaustive collection of the pottery of the empire, comprising its prehistoric, mediæval, and modern features. The task was a tremendous one, but with courageous resolution he set to work to obtain examples of every species of pottery known in Japan. The complete accomplishment of this was, of course, impossible, but his method and his opportunity enabled him to approach the realization of the ideal as but few men could.

INK PALETTE.
WATER HOLDER.
BRUSH REST.
BRUSH HOLDER AND SMALL POT ATTACHED BY LEATHER THONG, CONTAINING A SPONGE FULL OF INK.

Earthenware Drawing and Writing Utensils.

His scientific training, his experience as a collector in various fields of natural history from boyhood up, proved invaluable to him. He had acquired the habit of working unerringly forward on lines carefully laid out, forming a clear idea of his intentions at the outset, and following them unswervingly to the end. Therefore he collected his pottery precisely as a naturalist would collect species of insects or shells. If the object was new to him, he was not deterred by the price set upon it. As the ancient civilization of Japan has developed a class of antiquarians and connoisseurs who followed their fascinating inclinations with an enthusiasm and knowledge equal to that of any of their Occidental brethren, to obtain some of his most prized examples was a matter of no slight difficulty or expense.

Neither was he led to buy any piece simply because it was beautiful. This is a temptation which incessantly besets the collector in a field so intrinsically artistic as is that of ceramics; particularly when it happens to concern the work of one of the most artistic peoples in the world, and when the collector is a man of the artistic inclinations and talents of Professor Morse. If an artist had made the collection it would have been based on the considerations of beauty almost entirely, and its value would have been very slight in comparison with that which this possesses. Professor Morse would, however, as a naturalist, as soon have thought, when making a collection of shells, of choosing them for their qualities of luster, color, or grace of form, while his purpose was to draw from them the meanings of Nature in their creation and structure, as he would of allowing considerations of beauty to prevail in the choice of any of these examples of pottery, after he had once conceived his purpose of making this a representative collection.

But, while not seeking beauty, beauty has come to him in abundance. It has probably come even in a greater measure than it would if it had been his main object. For that which he sought was very largely beautiful. It represents one of the commonest products of a highly-æsthetic people, whose artistic nature could hardly help being applied thereto in a very great degree, and manifested in ways adapted to the qualities of the materials and the uses to which they were put. An artist in collecting would almost inevitably have been limited to a comparatively narrow range of forms and examples, such as would have brought themselves into his notice, but under the comprehensive scope adopted by Professor Morse, including every possible variety of pottery made throughout the empire — both in specimens and material employed, and period as well as method of manufacture — there has, as a matter of course, been brought together, incidentally to the main object, an uncommonly wide range of beautiful forms, colors, and designs. This collection, therefore, includes, as a feature of its scientific worth, a most thorough presentation of the artistic activity of the Japanese people as illustrated in their ceramic art, such as no collection made from a purely artistic standpoint would be able to show.

In forming this collection Professor Morse attempted to get specimens from every province where pottery was manufactured, and he also endeavored to secure every kind of object made in pottery. Other special efforts were to obtain every kind of "mark," whether stamped, incised, or painted, and also to get together, as far as possible, specimens showing chronological series of the leading types. The result of this has been the *most complete collection of Japanese pottery in the world*. There is not the slightest exaggeration in the statement that all the leading collections yet made would not, if combined, even distantly approach this collection in variety of objects, different provinces represented, numbers of makers, marks, etc. Other collections hitherto made have consisted chiefly of beautiful objects. It follows that in them are represented but few provinces and makers.

There are, to be sure, some exceptions. The Japanese collection at the South Kensington Museum, in London, for instance, was made with the express purpose of showing some of the features aimed at more comprehensively by Professor Morse. This collection, which was first exhibited at the Centennial Exhibition at Philadelphia, is extensively known through the excellent Art Hand-Book of the South Kensington series, edited by Mr. Franks, the Director of the British Museum. With the exception of the South Kensington collection, the various American and European collections of Japanese pottery consist almost wholly of specimens either remarkable solely for their beauty or their oddity — the grotesqueness which, in popular estimation, forms one of the main characteristics of Japanese art. Little do they know Japanese pottery, however, who judge it by such a standard.

Such questions as place, maker, and age are rarely considered in the formation of these collections, whose character may be realized by imagining a collector of etchings, for instance, who cared only for impressions remarkable for oddity or beauty, having no regard for the names of their artists nor the period of their production. A collection of this kind, while it might be attractive, would in no sense have educational or systematic value; it would be useless for either reference or study. A conception of the poverty of such collections arises upon the consultation of the beautiful work on Japanese marks and seals by Mr. Bowes, who must have had access to many private collections, and yet he gives only eighty-seven marks, embraced under five provinces, in the specimens of faience represented. In the works of Audsley & Bowe on the "*Keramic Art of Japan*" there are described

Example of Glazing.

but twenty-seven different wares from fourteen provinces. In the Morse collection are nearly four thousand specimens, with four hundred and fifty-five different marks, and over seven hundred different wares.

It is a fact that, with few exceptions, the public and private collections of Japanese pottery hitherto made represent no knowledge whatever of Japanese ceramic art, bric-à-brac dealers in Paris and London being the main sources through which they have been procured. Professor Morse's collection, however, was made by himself in the course of his various journeys in Japan, embracing provinces from the extreme north to the southermost portion of the Empire. His opportunities were, therefore, unrivalled, and it is hardly conceivable that a combination of circumstances so favorable could occur again. In the first place, as a pioneer in the task, he had the full reaping of a field from which followers in the same line must content themselves with gleanings. Moreover, Professor Morse enjoyed exceptional opportunities of coming into contact with the best sources, while his sympathetic and companionable personality, imparting his own enthusiasm to those with whom his searches brought him into contact and enkindling them with the desire to forward his work, was not one of the least factors in his success. Thereto must again be reckoned his scientific qualifications which enabled him to know just what he wanted and direct himself almost unerringly to the very place where it was to be found. The duplication of this collection, or the formation of one equally representative, would be a contingency so remote that it may safely be set down as an impossibility. Even were it possible, it would necessitate an expenditure so great that the value set upon this collection would be trifling in comparison.

A few items may give a slight idea of the richness of this collection. Nearly two thousand of these specimens were identified by the late Ninagawa Noritane, the famous Japanese antiquarian and author of the beautiful illustrated work on pottery, entitled "*Kwan ko dzu setsu*," a superb example of native reproductive art and typography, its colored lithographs being strikingly accurate copies of the originals, both in drawing and in delicacy of color. Professor Morse has, with few exceptions, every kind of ware described in Ninagawa's work: he possesses thirty of the original specimens figured therein, and also thirteen of the original specimens figured in the unpublished plates of that author.

After the death of Ninagawa, Professor Morse employed Mr. Kohitsu, an expert in the National Museum at Tokio, to assist him in the identification of his collections, and was in frequent consultation with a number of other pottery experts. He possesses a rare treasure in the shape of Ninagawa's annotated copy of his work, besides many of his original drawings, notes, memoranda, etc., and he has adopted every possible measure to ascertain correctly the history of each piece as conveyed by the locality of its origin, the identity of its maker, and its age; he has also sought to interpret every mark. In consequence, the collection is in the most perfect order, and classified according to the provinces and kinds of pottery.

Whoever should expect to see in this collection a kaleidoscopic and dazzling array of color, with all manner of elaborate design and strange form, will be disappointed. It does not attack the eye; it quietly, gradually absorbs the attention of the beholder whose senses are capable of the appreciation of subtleties of tone and grace of form. It affords a revelation of the exquisite æsthetic taste of the Japanese people. There are probably very few of us, if there be any, who are capable of fully realizing the pleasure which a Japanese connoisseur would have in going over these examples; noting the hardly-perceptible *nuances* of color, or the delicious qualities of the various glazes which, as the hand caresses them, impart new ideas of the æsthetic capabilities of the sense of touch, almost realizing the marvellous words of the author of "*Some Chinese Ghosts*," Lafcadio Hearn, in his "*Tale of the Porcelain God*," describing the making of a wondrous vase counterfeiting "flesh moved by the utterance of a Word, creeping to the titillation of a Thought."

The importance of pottery in forming an estimate of the Japanese may be seen from the fact that it stands at the head of their arts, a reputation as an amateur potter being the acme of artistic merit, while the wealthy men of *leisure and refined tastes* delight to employ themselves in the amateur potteries which they have built attached to their homes.

Form to be expected in porcelain rather than earthenware.

Probably no institution has had a profounder influence upon the pottery of the Japanese, as upon many other arts of that people, that the peculiar tea-ceremonies, for which particular rooms or buildings are set apart, constructed expressly for the purpose. As Professor Morse says, a volume might be filled with a description of the various forms of buildings connected with these observances; and, indeed, another volume might be filled with the minor details associated with their different schools. The party comes about by the host inviting a company of four to attend the tea-ceremony, and in their presence making the tea in a bowl after certain prescribed forms, and offering it to the guests. It seems as if a ceremony of this description must have had a religious origin, but it is said to be based purely upon etiquette. Many books, Professor Morse tells us, are devoted to the exposition of the different schools of the ceremony, illustrated with diagrams showing the various ways of placing the utensils, plans of the tea-rooms, and all the details involved in the observances. In his delightful volume, "*Japanese Homes and their Surroundings*," he says of them: "Particularly have they affected the pottery of Japan; for the rigid simplicity, approaching an affected roughness and poverty, which characterizes the tea-room and many of the utensils used in the ceremony, has left its impress upon many forms of pottery. It has also had an influence on even the few rustic and simple adornments allowed in the room, and has held its sway over the gardens, gateways, and fences surrounding the house. Indeed, it has had an effect on the Japanese almost equal to that of Calvinistic doctrines on the early Puritans. The one suppressed the exuberance of an art-loving people, and brought many of their decorative impulses down to a restful purity and simplicity; but in the case of the Puritans and their immediate descendants, who had but little of the art-spirit to spare, their sombre dogmas crushed the little love for art that might have dawned, and rendered intolerably woful and sepulchral the lives and homes of our ancestors."

UTENSILS FOR TEA CEREMONIES.

1. Iron kettle. 2. Earthenware furnace. 3. Mill. 4. Charcoal basket. 5. Slop-bowl. 6. Rest for kettle-lid.
7. Rings to lift kettle. 8. Bamboo mat to rest kettle on. 9. Bamboo dipper. 10. Water jar. 11. Tea bowl. 12. Bamboo stirrer.
13. Incense box. 14. Tea jar. 15. Teaspoon (bamboo). 16. Bag for tea jar. 17. Feather duster. 18. Tongs.

The rules of these ceremonies forbid any conversation on worldly subjects, such as politics or scandal; flattery is also forbidden, and no distinction of rank is observed. Usage forbids the meeting to last over two hours.

Among the pottery utensils used in the tea-ceremony are the furnace, water-vessel, jar to hold the powdered tea, pan for ashes and tea-bowl. The furnace varies somewhat in form, generally consisting of a vessel on three legs; in the upper part is an opening to create a draft, and in this upper part rests an iron vessel for boiling water, with two handles and a lid. The water-vase, holding the water for replenishing the supply for the utensils, is generally rudely made, and often provided with a lacquer cover. The tea-jar, one of the most treasured objects, is usually small and oviform, of hard

pottery, decorated simply with a mottled glaze, and having a flat ivory lid. It is often encased in a rich brocade bag, sometimes again enclosed in a lacquer box, with a coarser outer bag enfolding it. The tea-bowl is purposely made very rudely, somewhat varied in shape, sometimes shallow like a saucer, and again nearly cylindrical. Extreme care is taken to have the edges smooth to the lips. The decoration is very slight. The ash-pan is shallow, of unglazed ware, and with edge curved inwards. The use of incense forms part of the tea-ceremony. The incense-boxes are of varied forms, and usually small in size. The incense-holder exhibits considerable variety, and is sometimes made in the forms of men, beasts, or birds.

Other objects which the Japanese make in pottery are as follows: The fire-holder — from which the smoker of tobacco lights his pipe — a vessel of usually small size, and cylindrical in form. A small earthen brazier, somewhat pear-shaped and with an opening on one side, is used for keeping the hands warm. It is sometimes very grotesquely shaped. Pottery objects are used at the writing-table, consisting of small ornamented screens, used as paper-weights, vases for washing the brushes or pencils used in writing, vases for holding them, and small closed vessels for supplying water to the ink-stand. These water-vessels are very diverse in form, always with a diminutive spout to allow the water to issue drop by drop, and a small hole on which to place the finger to regulate the flow.

The vessels for saké, the intoxicating liquor distilled from rice, are chiefly bottles, either square, round, or polygonal, and jugs with spouts something like kettles or tea-pots.

Tea-pots exhibit two forms; one like the ordinary European vessel and the other with a hollow handle at right-angles to the spout, introduced in the fifteenth century. The tea-cups are in the ordinary form, without handles, and when there is a saucer it serves only as a stand for the cup. Plates and dishes used at meals are chiefly saucer-shaped, and when the flat edge is used it is an innovation to suit European habits. Rice is eaten in small bowls, and small saucers are used to hold comfits. Cake-boxes are made of pottery in a great variety of forms. Coarse pottery is used for all kinds of kitchen utensils, and also for gardening and agricultural purposes.

Flower-vase decorated with the stump of a cherry branch.

A Candlestick of Akatsu ware.
[From "*Japanese Homes and their Surroundings.*"]

All these forms are to be found in great variety in the Morse collection, as well as many used for more particularly ornamental purposes. One of the most interesting classes is that of the flower-vases; the Japanese people, like nearly all Orientals, delighting ardently in flowers. Their flower-vases are given a remarkable variety of form, often exceedingly picturesque. They never sin in the common Occidental direction of giving flower-vases strong colors, for they are aware that such a proceeding would impair their object as hardly anything else would, robbing the flowers themselves of much of their effect. They invariably make their flower-vases with inconspicuous neutral colors, and, when not in conventional shape, the vase usually is designed to suggest, when in use, an association of the flowers with some natural object, as a tree-stump, a section of its trunk, a twig, or branch; a section of bamboo, etc. This natural effect is aided by the habit of disposing the flowers, which is usually in single sprays or blossoms. They are rarely crowded in masses. The flowers are recognized as the chief objects of interest, and the vases are so used as to strengthen their effect. The neutral tones of the vases materially assist in carrying the attention to the beauty or brilliancy of the flowers, and, when it is diverted to the picturesque form of the vase, it is again led to a contemplation of that which seems to be the outcome thereof.

Nearly all the Ceramic wares from Japan which interest us by their intensely "decorative" design and ornamentation do not represent Japanese tastes in the least. They are made solely for the European and American markets, and are contemptuously regarded by their manufacturers as meretricious, only serving to meet the demand of depraved and vulgar tastes!

A marked feature of the collection is the very subordinate place occupied by decorative ornament. In most cases it is merely incidental, its purpose evidently being to reinforce or complete the impression conveyed by qualities of form and color. For æsthetic effect the main reliance appears to be the subtile qualities of color-tones, and delicate distinctions in the methods of glazing. Even a superficial acquaintance with the collection makes it conceivable to an appreciative visitor what rare measures of delight may be obtained by the trained connoisseur in the examination of these manifold qualities of tone and texture; for instance, recognizing in the peculiar glazing of some diminutive tea-jar the consummate skill of a famous artist whose hand has given it a classic value, making it as precious as a jewel. Distinctive qualities of worth may be detected in the disposition of the glaze, apparently spilled carelessly over the upper portion of the vessel and trickling down over the lower part which betrays the nature of the raw material — the glaze terminating irregularly and fringe-like — recalling rain-drops and tears in their semi-translucent pearliness. Then there are the exquisite gradations of coloring — faint flushes and indeterminate suggestions of yellows, greens and pinks, and the indescribable variations and comminglings of blues and grays. Again, the many effects of density or lightness in the composition of the glaze, sometimes, for instance, filled with thousands of tiny bubbles, like sparkling water.

A fictile Tour de force.

The ornamentation is composed variously of bits of mythological incident or character; scraps of domestic scenes; glimpses of landscape, with the sacred mountain, Fujiyama, frequently appearing; figures of animals, fishes and insects; birds singly or in flocks, with, of course, the stork one of the most commonly represented; the five monstrous animals of mythology, the dragon, the phœnix, the kyrin (a combination of deer and bull, with a horn on its forehead), a lion monster, and the sacred tortoise with a hairy tail; while trees, plants, grasses and flowers are used with remarkable vigor and grace. Of the trees the pine, the bamboo and the plum are in particular favor, and commonly appear in combination. These, collectively known under a modification of their Chinese names as *sho chiku bai*, form an emblem of longevity.

This combination of pine, plum and bamboo is notably found on all the Tosa bowls in the Morse collection. A noteworthy decoration of pottery designed for birthday gifts is a lobster, the significance of which is that it conveys the wish, "May you live to the age when your back becomes as round as this lobster's!"

Of flowers, most frequent are the sacred lotus — an emblem of Buddha, the chrysanthemum, the iris and the peony. The chrysanthemum, forming the imperial emblem of Japan, is very familiar in a conventionalized pattern, having little resemblance to the natural flower. It is hardly necessary to call attention to the peculiarity of the Japanese in disposing their designs in strange-shaped panels, often overlapping; and occupying spare spaces and borders with diapers of manifold variety, including the Greek fret and other classic patterns. Among the ornaments are often conspicuous some of the badges of the Japanese heraldry, as that of the family of the Mikado, the three leaves and flowers of the *Paulownia imperialis*, known in Japanese as the *kiri-mon*, treated conventionally, and the emblems of various other noble families. A notable bit of decoration upon one of Professor Morse's pieces, over a century old, forms a token of the old Dutch influence, when that nation enjoyed the monopoly of intercourse with the Island Empire. It is a Japanese imitation of one of the old Dutch landscapes familiar to us on blue china, and it is interesting to perceive how the prosaic Dutch character of the original has been resolved into Japanese grace in the interpretation.

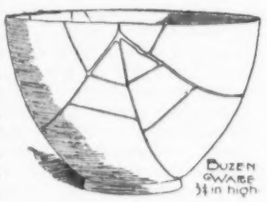
The Japanese treatment of fractured pottery is characteristic. They scorn the idea of attempting to conceal the fact that a piece has been broken. They mend it carefully, and then accentuate the fact of mending by tracing along the lines of fracture narrow bands of gold, silver, or other color, usually red. These irregular, and often branching or zigzag marks have the effect of intentional decoration, quite in accord with the apparently casual methods of Japanese ornamentation. Few persons not knowing this would

detect the real purpose of these lines. A mended piece, instead of imparting a shock of disappointment to the beholder when at last he detects a cunning concealment, at once frankly confesses its defect, which thus appears transformed into a virtue, as the lines often heighten the beauty, and the worth of a valuable old piece does not appear to be impaired thereby.

Edge of dish mended with lacquer.

There is, of course, a great variety of marks. Dates are more infrequent than with the Chinese, but the *nengo* is occasionally found, like the Chinese *ni enhao*, as an arbitrary name for the reign, or portion of the reign, of an emperor.

Japanese pottery is designated by the name of the province, by the name of the city or town of its manufacture, of some district or particular street in a city, by some poetical or sentimental name, as that of the garden in which the pottery is situated, or most common of all, by the name of the maker. It thus follows exactly the same lines adopted in the naming of our Occidental pottery and porcelain. The Rookwood pottery, for instance, illustrates the poetical designation with us, Rookwood having been the name of the suburban estate near Cincinnati where that famous factory is situated.



Bowl mended with gold lacquer.

The name of the potter is, however, the most common of Japanese marks. This is unlike the Chinese custom, and is ascribed to the individual character which the Japanese maker gives to his wares. The Japanese pottery is small in size, and while in China every piece passes through the hands of a number of workmen, so that no piece could be marked as the work of one man, in Japan the small factory is carried on by a single potter and his family, in the house where he lives, so that he has a pride in putting his name to his wares as a guaranty. This is a particular characteristic of the older wares, made chiefly for home markets. The mark is sometimes scratched, sometimes stamped with a seal, and sometimes painted. Some of the princes occasionally bestowed upon famous potters special seals to be used on their wares.

Some idea of the extent of the Morse collection may be obtained from a comparison with the few large collections of wares whose catalogues have been published. The best known catalogue is that already mentioned, made for the South Kensington Museum by Mr. Augustus W. Franks. This catalogue, as we have seen, forms one of the South Kensington Art Hand-Books, and to it the writer is indebted for much of the technical information which has been here presented. The Japanese made this collection specially for display at the Philadelphia Centennial Exhibition at the suggestion of the South Kensington authorities, their museum to be its ultimate destination. The excellent catalogue of Mr. Franks has given the collection a reputation almost classical. That portion represented by faïence and soft earthenware contains forty-eight different marks representing fifteen provinces.

Another celebrated collection, that made by Captain Brinkley, a catalogue of which was published by Mr. Greey of New York, possessed in its faïence sixty-one different marks representing twelve provinces.

The Morse collection contains over 700 different marks, representing thirty-five provinces. To exhibit the contrast in another way,

Lamp — Akatsu ware.
[From "*Japanese Homes and their Surroundings.*"]

the South Kensington catalogue records 65 kinds of pottery representing 24 provinces. The Brinkley catalogue records 81 kinds of pottery representing 22 provinces. The Morse collection possesses over 400 kinds of pottery representing 54 provinces. Regarding the number of specimens of faïence, the South Kensington catalogue records 167 specimens; the Brinkley catalogue, 296; and the Morse collection contains nearly 4,000. The Brinkley catalogue notes 39 specimens of faïence from the collection of the famous antiquarian, Ninagawa Noritane. The Morse collection has 420 specimens from the same source.

The late Louis Agassiz laid down the maxim that in studying a species the student must have before him an abundance of specimens. This maxim is equally true in regard to Japanese pottery. In order to become familiar with the pottery of any maker, one must have examples of his early as well as his later works. And this necessity becomes all the greater when one undertakes to gain a familiarity with Japanese pottery under the larger groups of classification by provinces, as when we speak of Tamba, Higo, Satsuma and the like, for under these names are included many quarries, potteries and periods.

In no way can the wealth of material in the Morse collection be appreciated better than by comparing the number of his pieces under provincial grouping with the South Kensington and Brinkley collections, as shown in their respective catalogues. It must be remembered that porcelain is not included in any of these enumerations, and it should also be borne in mind that, with few exceptions, only the more important and attractive pieces are included in the numbers given for the Morse collection. The following table tells the story:

PROVINCE.	So. Kensington.	Brinkley.	Morse.
Awaji	5	5	35
Bizen	16	11	83
Buzen	0	1	17
Chikuzen	6	10	124
Echizen	0	1	4
Harima	0	1	59
Higo	4	9	94
Hizen	7	1	149
Idsumi	1	0	17
Idsumo	9	10	61
Iga	3	0	51
Ise	5	12	140
Iwaki	3	1	64
Kaga	8	37	62
Kii	1	6	39
Musashi	9	3	90
Nagato	5	0	56
Omi	5	4	125
Owari	11	21	615
Satsuma	12	30	169
Settsu	4	1	58
Tamba	2	3	81
Tosa	1	1	21
Totomi	1	1	49
Yamato	2	4	65
Yamashiro	41	139	542

And of many other provinces of which the first two catalogues possess no example we have in the Morse collection, notably Sanuki, 26; Aki, 19; Suwo, 37; Chikugo, 9; Tsushima, 10, etc.

It is to be hoped that this almost invaluable collection may be guarded against the danger of accidental destruction, or an almost equally deplorable destruction through dispersal, by such public-spirited action on the part of some of our many persons of means and beneficent disposition as would secure it for some institution where it might remain safe in its entirety, accessible to the people at large. Not to mention its value as the most complete instrumentality for the study of one of the most important aspects of Japanese art, its worth as an educational means for our own people is almost beyond calculation. Professor Morse is frequently applied to by art students, and by those technically interested, for permission to make studies of certain examples. For instance, the celebrated Rookwood pottery at Cincinnati, the leading art-pottery of the United States, sent to Salem one of its most talented designers, who spent several days in making drawings of a few attractive pieces, and even Japanese artists have come expressly to make studies of some rare examples, the like of which could not be found at home, to be sent back to serve as models for native manufacture. The great art tile-works of J. G. & J. F. Low at Chelsea have also obtained numerous hints from this collection for some of their best designs.

A Potter's Freak.

In the collection at South Kensington, the visitor may notice here and there a vacancy, with a card in the place of some specimen, bearing such words as "Loaned to the Wedgewood Pottery," or some other well-known factory of the kind. One of the rarest examples may be absent for two or three months, undergoing close study at the hands of artisans, and thus effecting a permanent influence on English ceramic art. With this vastly superior collection made similarly accessible to the public, and particularly to those more nearly interested, and with the growth of our art-industries, its influence and value would be inestimable.

SYLVESTER BAXTER.

DECENNIAL INDEX OF ILLUSTRATIONS. — We have in course of preparation a classified index of the illustrations published in the *American Architect* from 1876 to 1885 inclusive. We find that in very many cases the *cost* of the building has not been stated and we, therefore, ask our contributors to furnish us the approximate cost of such buildings of their designing as have been published during the above named years.

ILLUSTRATIONS

[Contributors are requested to send with their drawings full and adequate descriptions of the buildings, including a statement of cost.]

SOUTH SIDE OF MAIN ROOM, CONTAINING PROF. E. S. MORSE'S COLLECTION OF JAPANESE POTTERY.

[Gelatine Print, issued only with the Imperial and Gelatine Editions.]

For description see article elsewhere in this issue.

VENICE BY DAY. AFTER AN ETCHING BY OTTO H. BACHER.

Although Mr. Bacher is but little over thirty (having been born at Cleveland, O., in 1856), he has won fame both at home and abroad. Elected a Fellow of the Society of Painter-Etchers, praised by Seymour Haden, called by the *Times* "a most formidable rival" of Mr. Whistler and likened by the *Saturday Review* to Meryon, his talent was readily recognized. He began to etch in the intervals of painting some ten years ago, and studied in Munich, and later in Venice, with Duveneck, and several other young American artists, who were much influenced by Whistler, then etching his "impressions" of the "Bride of the Sea." His plates are usually of moderate size and represent almost entirely either scenes in Germany or Italy. He has executed a number of etchings of Venice, and has lately completed a large plate of a view of Milan Cathedral.

HOUSE FOR MRS. MEAD, WASHBURN PARK, MINNEAPOLIS, MINN. MR. H. W. JONES, ARCHITECT, MINNEAPOLIS, MINN.

This house is to be built of logs for the first story, with rusticated shingles on the second story and roof, and to be treated with creosote stain. The octagonal hall in the centre of the house is to be finished in rustic oak, with the bark taken off, and the wood filled with dark filling, and to be polished. The fireplace in hall will be of round boulders, with oak shelf and panelling above of oak logs; the hall will run up two stories and have a circular balcony around it at second story, and be lighted from the top. The parlor and music alcove will be finished in white enamel with colonial detail. The cost will be about $12,000.

HOUSES FOR MRS. COLE, CLEVELAND, O. MR. CLARENCE O. AREY, ARCHITECT, CLEVELAND, O.

These houses were finished last spring at a cost of $17,000, including mantels, ten in all, gas-fixtures, furnaces and interior decoration. The houses were finished in natural pine, except the mantels and stairways, which were of hard wood. Some of the rooms were painted and stenciled simply, and others were papered.

SHOOTING-BOX AT TUXEDO PARK, NEW YORK. MR. R. H. ROBERTSON, ARCHITECT, NEW YORK, N. Y.

BANKING-ROOM, BANK OF MINNESOTA, ST. PAUL, MINN. MR. J. W. STEVENS, ARCHITECT, ST. PAUL, MINN.

NEW MATERIALS AND INVENTIONS.[1]

In treating such subjects as new inventions connected with building operations and architecture before an assembly of practical men, it may be as well to state at the outset that there are three things which it will be impossible for me to do. First, I cannot attempt to notice all the varied new inventions which the last few years have brought to light; secondly, I cannot avoid describing some inventions which are not new to many here; and thirdly, I cannot help omitting some which, in the opinion of many persons, are superior in interest to those which I shall describe. All that I can hope to do is — taking my own personal experience as a guide — to bring before your notice certain comparatively modern inventions which have interested me either on account of their ingenuity or of their practical usefulness. It must be borne in mind that it takes a very considerable time before a new invention becomes so well known and its utility so thoroughly recognized for its use to become almost universal; and, moreover, no one has a right to recommend the employment of new methods simply because they are new; a certain amount of experience of them is necessary first, and this experience can only be obtained in time.

I believe it is just twelve years since a paper on this subject was read in this room by Professor Roger Smith, and it is curious to notice that some of the novelties which he called attention to then remain almost novelties still, so conservative are we in matters connected with building. Our cousins across the water are far more inventive than we are, and I have had to go to them for several of the novelties which I shall bring before you. The American intellect seems to take nothing for granted, to look upon nothing as final, and to bend its whole endeavors to find out some way of improving any mechanical operation which has for some time been in use.

I think new inventions and discoveries are rarer in the domain of architecture than in other branches of industry, and for this reason: all new invention must be in a mechanical direction towards saving of labor, and as the best building has as much art about it as science, and as art cares far more for the variety obtained by individual effort than for the precision and exactness of mechanical repetition, architects (who, after all, exercise far more influence indirectly upon building than is sometimes imagined) are disposed to look somewhat shyly upon the facilities for doing away with individual labor, and to decry the reproduction of ornamental features by mechanical means. We are inclined to agree with Mr. Ruskin and to prefer a tiny bit of carving into which the workman has put his head and his heart, as well as his fingers, to any number of yards of machine-made moulding. And, within certain limits, we are right in this preference. But when we turn from the purely artistic to the practical and scientific side of architecture, we cannot be blind to the immense advantages which modern scientific discoveries give us over our forefathers, and we should be foolish if we did not make use of them.

Take, for example, the use of iron in building. It has completely revolutionized our methods, and enables us to economize space and to erect buildings in positions where it would have been impossible to do so without its employment. And it is for the architect to take any new materials which assert their structural superiority, and to adapt them to artistic forms and treatment, and granting the requisite ability, I do not believe there is anything that cannot be "invested with artistic merit," to use a phrase which we heard a good deal of a year or two ago, even though it be so utilitarian and, to most of us, utterly detestable, as a cast-iron front to a warehouse.

My remarks this evening must necessarily be somewhat unconnected, for the reason that the inventions which I have to describe have little or no connection with each other, but I will endeavor to work as much as possible upon the lines of our own specifications, that is, from the more purely constructive to the decorative portion of a builder's work.

We are all of us now so thoroughly imbued with the necessity of properly trapping and ventilating house-drains, and cutting them off from the sewers, that it is scarcely necessary to allude to these matters at all; but in connection with sanitation there is one discovery that has been made comparatively recently that demands a word or two of notice. I allude to the unsealing of traps. It used to be considered sufficient, if closets were trapped, to ventilate the soil-pipe alone, but the experiments made in the United States, at the instance of the Washington National Board of Health, and in this country by Mr. Stevens Hellyer, have proved to absolute demonstration that unless the traps themselves are ventilated they will be liable to be unsealed. There are two ways by which traps can be unsealed: first, by the momentum of any discharge passing through the trap itself; secondly, by the passage of a considerable quantity of water through a pipe with which the trap is connected. The passage of this water causes a momentary vacuum, by means of which the water is sucked out of the trap, and it is absolutely necessary, if the trap is to be a safe one, that all the trap-branches into the main pipe should have an ample ventilating-pipe carried up from them and branched into the main pipe above the point where the highest trap-branch enters it. This important fact cannot be too widely known, as it is certainly still the exception rather than the rule to have these branches ventilated.

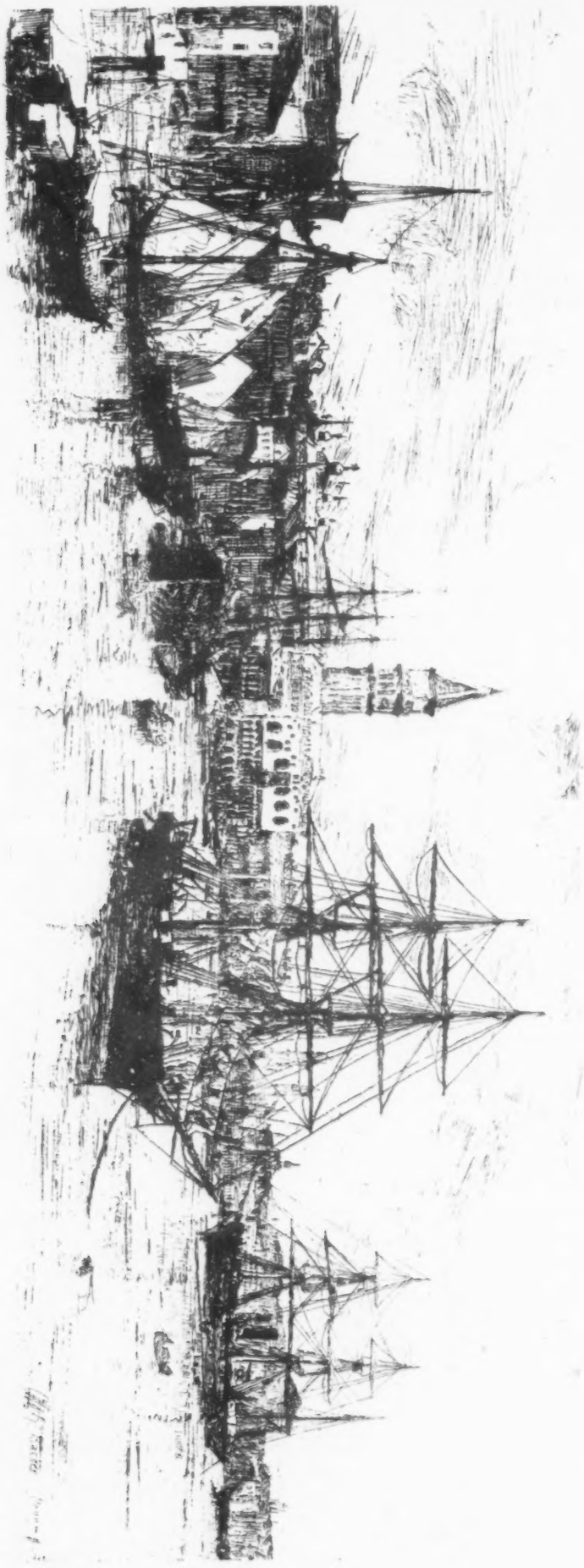
Before passing from the subject of drains and pipes, I should mention that increased experience all seems to point to the desirability of decreasing rather than enlarging the size of pipes; four-inch glazed earthenware pipes for house-drains, and three-and-a-half-inch lead pipes for soil-pipes, if properly connected and laid, will suffice for all purposes, and will keep much cleaner than those of larger bore, always supposing they are properly flushed out. In fact, Mr. Hellyer has used soil-pipes of no more than two-and-a-half inches in diameter.

I do not think I need occupy your time in describing concrete as a building material, as there has been more than one evening in the last few years devoted to the subject, nor shall I attempt to enumerate the various kinds of ornamental bricks for walls which are now produced by various manufacturers, of excellent quality and design. I will merely ask you to examine two comparatively recent forms of concrete paving — Stewart's granolithic and what is called the "impenetrable" paving, both of which appear to me to be excellent.

Terra-cotta also is so well known to all of you, and its usefulness as a building material is so thoroughly established that I need not detain you on this subject further than to mention a new form of nosing for stone or concrete steps invented by Messrs. Doulton. This is called the silicon tread, and is a kind of terra-cotta, *i. e.*, clay burnt as hard as it is possible to bake it. These treads were used for three years at the recent exhibitions at South Kensington, and must have had several millions of persons passing over them.

There is one comparatively recent invention, somewhat in the nature of brick, which is not, I think, so well known as it deserves to be. The impossibility of getting good fixing to ordinary brick walls has necessitated the use of wood bricks or plugs, which have two drawbacks: (1) that they are liable to shrink, and therefore lose

[1] A paper by Mr. John Slater, read at the Eighth General Conference of Architects held under the auspices of the Royal Institute of British Architects, May 4.



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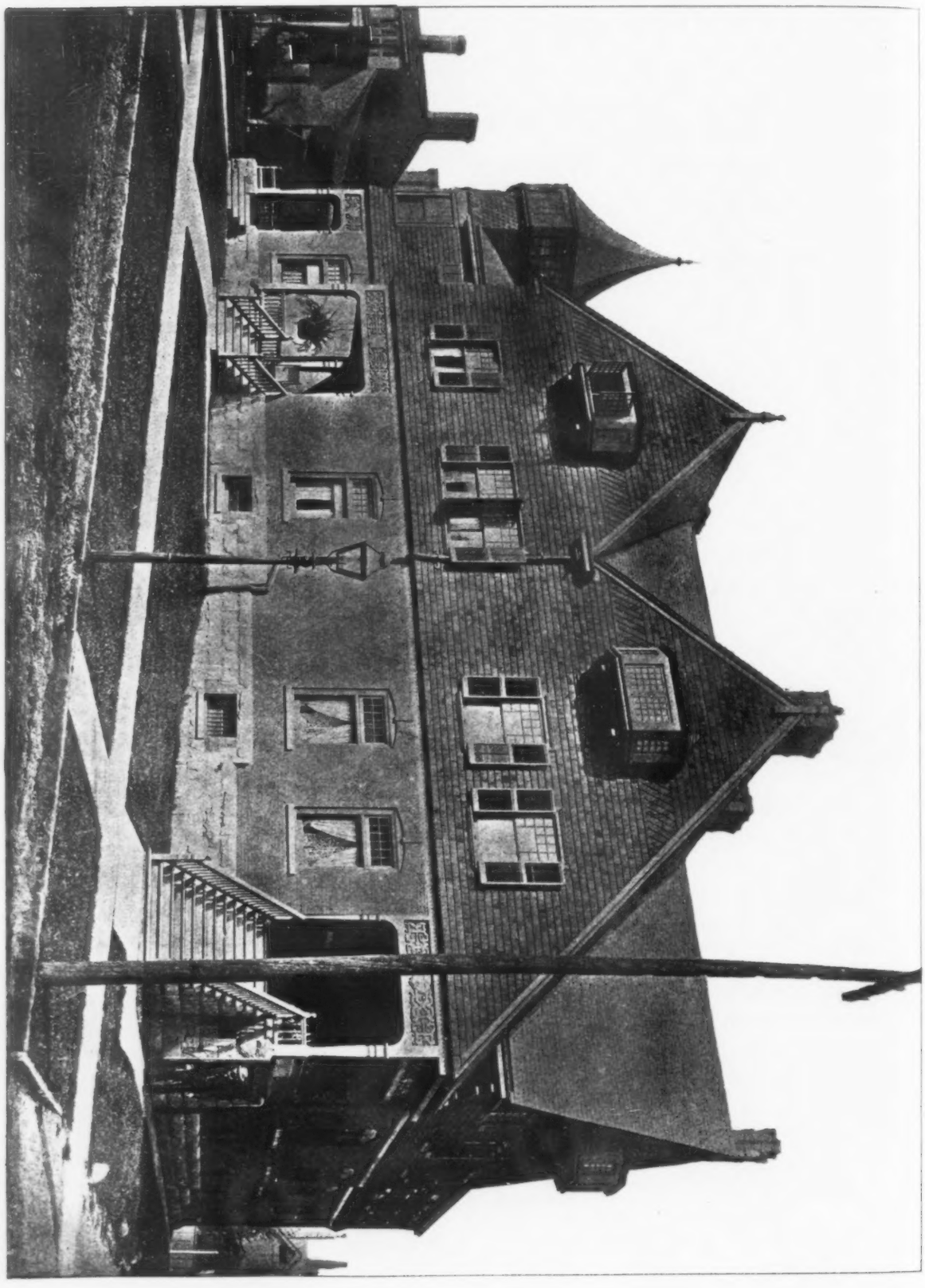

Houses for Mrs. Cole, Cleveland O. C.O. Arey, Architect

Heliotype Printing Co Boston

Log-house for Mrs. Mead, Minneapolis, Minn.

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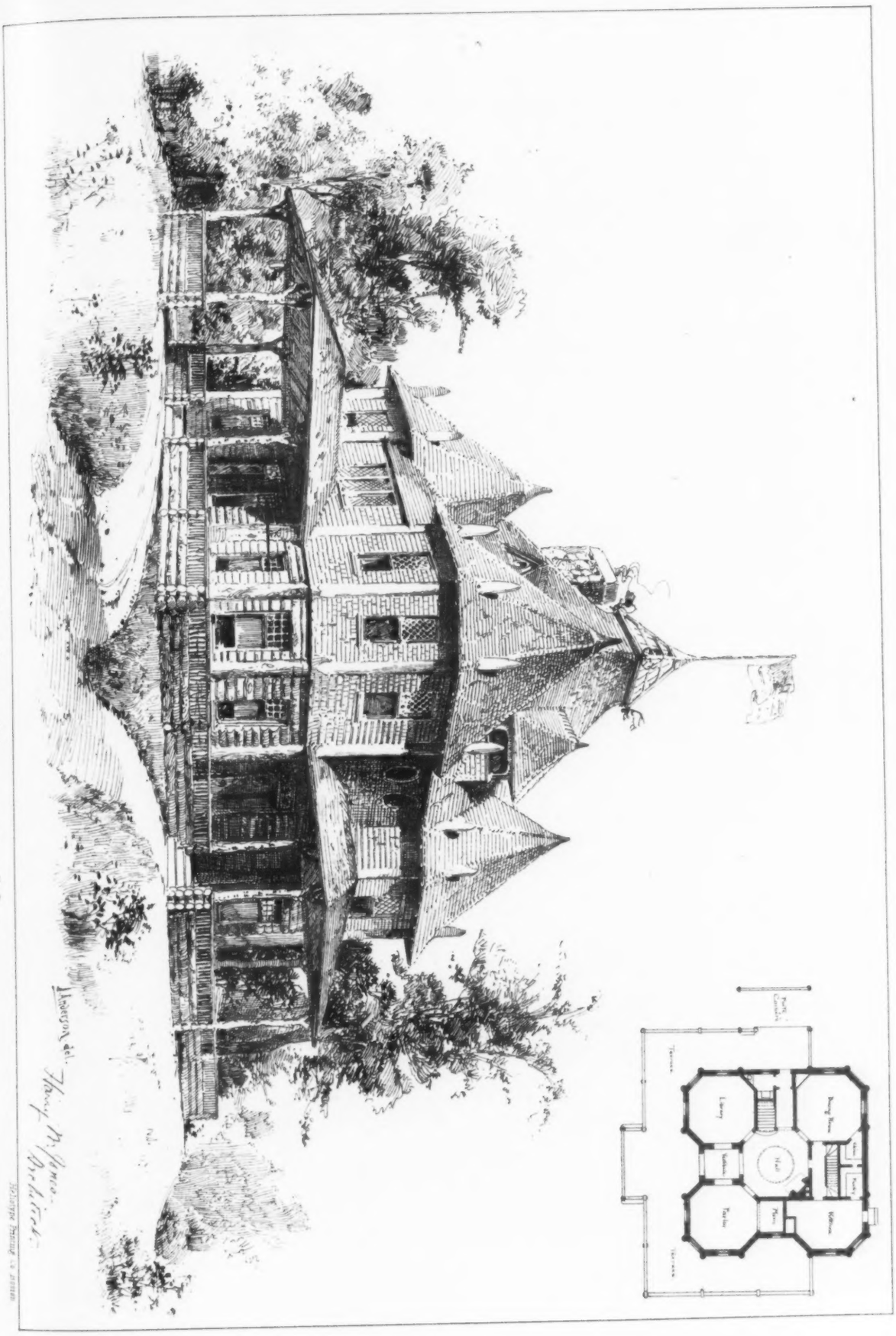
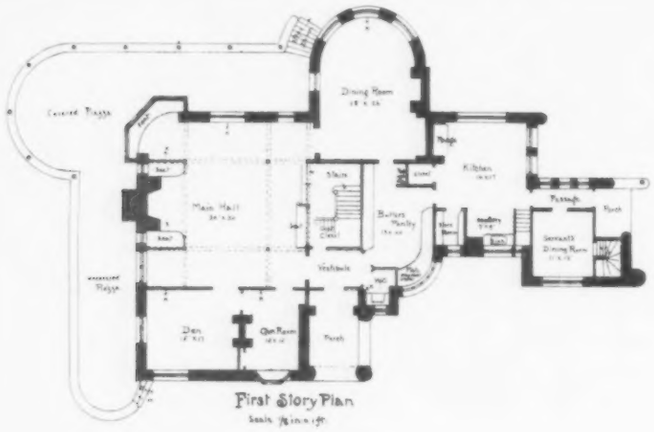
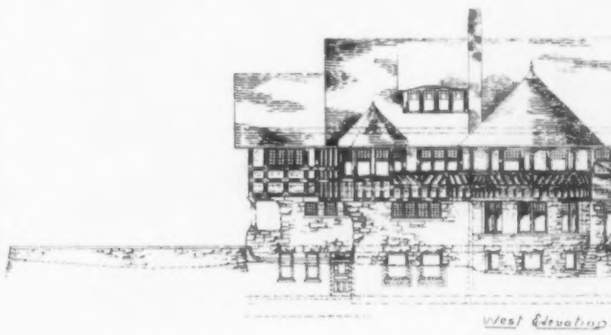


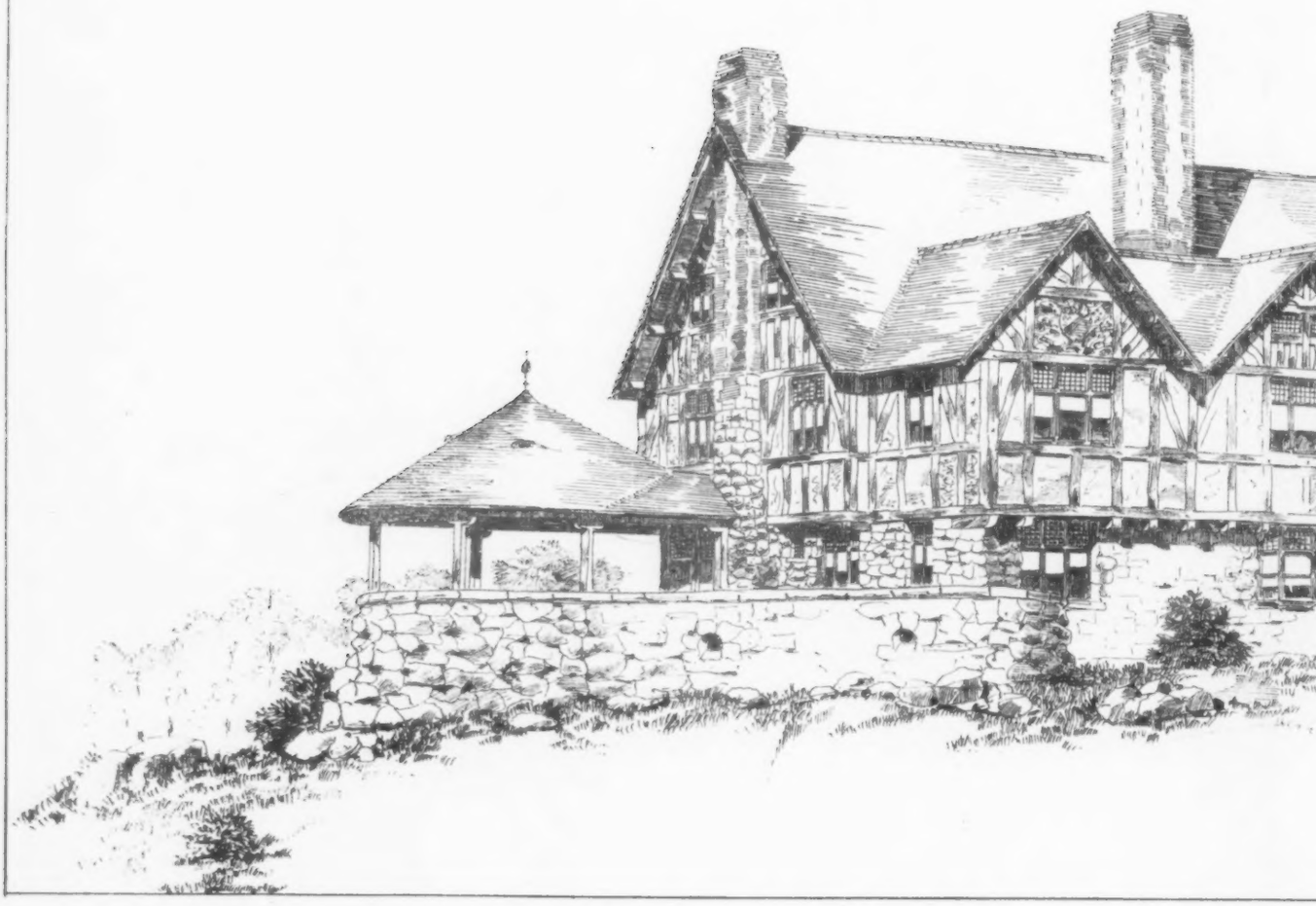
Log house for Mrs Mead, Minneapolis, Minn.



First Story Plan



West Elevation



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East Elevation

Second Story Plan
Scale 1/8 in = 1 ft.

Shooting Box at Tuxedo Park, N.Y.
for James Lawrence Breese Esq.

R.R. Robertson, Architect.
12 E. 13th St. N.Y.

Heliotype Printing Co. Boston.

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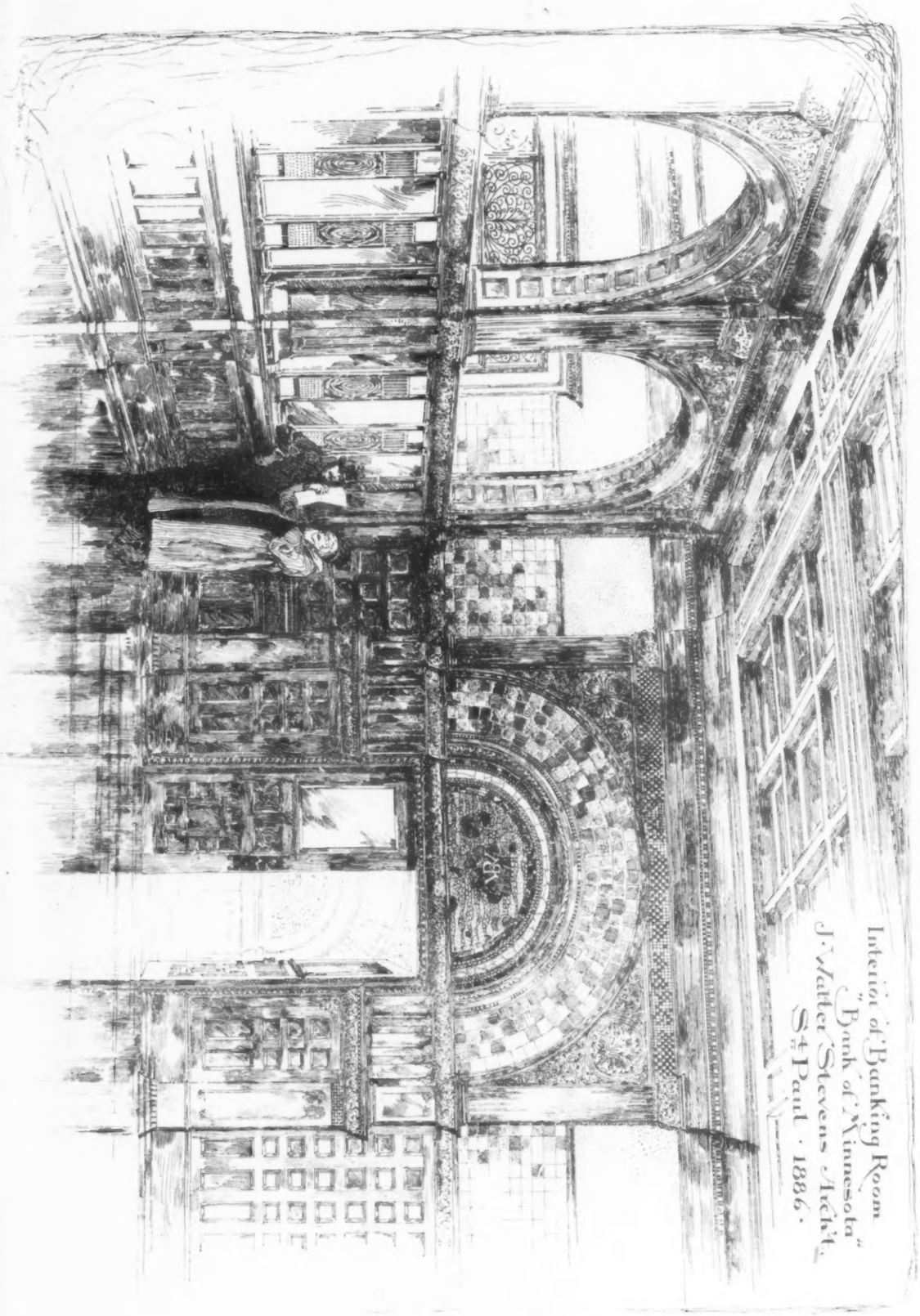

Interior of Banking Room
"Bank of Minnesota"
J. Walter Stevens Arch't.
St Paul. 1886.

their hold on a wall; and (2) that they are certain sooner or later to decay. Mr. Wright has endeavored, with much success, to get over this difficulty by making what he calls "coke-breeze fixing blocks." These are made of the same size as an ordinary brick, and can be built in the walls wherever required, and their constitution is such that they will hold nails as well as wood. For the purpose of fixing skirtings, dados, and linings of all kinds on the interiors of brick walls, I consider them admirable, and even more useful are they for external use if a portion of a wall is to be hung with tiles. Every one knows how unsatisfactory wooden fillets are in such situations, as they are certain to get rotten before long, but these coke-breeze blocks are practically indestructible. Another method of using them is when wooden floor-boards are required over a concrete floor, as they obviate the necessity of bedding wood blocks in the concrete, a plan which never commended itself to my mind.

The next subject to which I shall ask your attention is that of fireproof construction. The enormous losses which such huge conflagrations as have been seen too often of late years in the city of London cause to the insurance companies have had the effect of making these companies exceedingly shy of insuring large warehouses except at very high rates of premium, notwithstanding their being what is called fireproof. The reason is that, practically, such buildings do not turn out to be fireproof at all. If the insurance companies could be convinced that a building was really and not theoretically fireproof from top to bottom, we may be quite sure that for their own sakes they would not decline the insurance; and it is well worth the while of those who are erecting these gigantic piles of buildings which we see around us to consider whether the sum that would have to be expended to bring about this result would not be, in the long run, a most wise economy.

Iron and stone used to be considered fireproof materials, but sad experience has shown the fallacy of this opinion time after time. In America, the system of fireproofing has been carried much farther than with us, and it is there laid down as an axiom that no building can be considered fireproof unless the whole of the structural ironwork used in it be covered with a really fireproof substance. I wrote to one of the largest firms in the States, who make a special business of fireproofing, and asked for particulars of their practice — the Wight Fireproofing Company — and they were kind enough to send me an illustrated pamphlet from which some diagrams have been prepared. Some of the methods adopted do not differ widely from those in use in this country, such as Hornblower's system, but as the whole subject is one of great practical interest and importance, I will endeavor to explain the American systems somewhat in detail.

The first kind shows a combination of iron joists, concrete, and hollow fire-clay tiles of different depths. The hollow tiles are temporarily supported by centering, and are set in cement, the middle tile acting as a key-stone. The bottom edges of the tiles are grooved, in order to give a good key for the plaster of the ceiling, and on the top of the flat arch thus formed concrete may be laid of any thickness that seems desirable, thus entirely encasing the iron girder. The weight of the deeper arch is about thirty-five pounds per foot super. In erecting a new building there is, of course, no difficulty in providing a floor of this kind, but if one has to deal with ordinary wooden joisted floors in actual existence, it would be a very expensive matter to replace them with iron and concrete floors.

The next diagram shows a method of making wooden floors practically fireproof on the underside. This is done by flat interlocking fire-clay tiles carried by iron clips screwed to the joists, the underside of these tiles being grooved to form a key to the plaster. A space of two inches is thus left between the plaster and the wooden joists, and as the tiles themselves will stand almost any heat that can be brought to bear on them, the joists are absolutely protected; on the upper side, fine concrete or pugging might be used. This system of fire-clay ceilings can be affixed to existing floors by simply hacking off the laths and plaster. I believe this system to be absolutely new to this country, and it appears to me both simple and effective.

If iron columns are to be fireproofed, it is done by encasing them with fire-clay blocks, which are grooved and are secured by iron plates with claws, which fit on the rivet-heads. In circular cast-iron columns a metal band is brought round the column, hooked together, and dropped into the groove of the blocks. In either case a heavy bed of mortar is next applied, and then another course of blocks is bedded, or, as the Americans say, "crowded down" over the band or plate. This process is continued till the column is entirely encased, then it is plastered with Keene's or Parian cement, making a good surface for decoration.

No words of mine are needed to show how much more perfect such a system as this is, if thoroughly carried out, than what we are in the habit of using here. Soon after I had obtained these particulars from the Wight Company, Mr. Doulton, of Lambeth, kindly sent me a notice of his new patent, the Doulton-Peto fireproof blocks. These are extraordinarily like the first kind of American arch-blocks which I described, in fact, I believe the idea was obtained from the American system, and I have no doubt that Mr. Doulton will carry this system farther in the way of casing columns, etc. I do not think, however, he has as yet manufactured anything like the flat tiles for wooden joists.

I am not going to occupy your time further on this subject of fireproof floors, except to call your attention to an English system, whose merits I estimate very highly; I allude to Lindsay's steel decking, of which I have a model here. This consists of a series of steel troughs riveted together and supported either on walls or on girders, and filled in with concrete. The strength and rigidity of the small troughs are most surprising, and the small space which they occupy is even more astonishing, as for a space of thirty feet, the depth of the decking need only be five inches to support a load of one-and-one-half hundredweight per foot super. Another great advantage is that brick partitions can be placed on this decking and concrete in any position independent of walls or girders underneath. This flooring is largely used in the National Liberal Club.

With regard to this steel decking, it is a curious fact that many years ago a manufacturer, whose name I have forgotten, patented every form of corrugated iron which he thought could be manufactured, and left out the very one which has proved most useful. This form is based on the strictest scientific methods, as the top table is made thicker than the sides, and the sectional strength thereby greatly increased, and the various sections are riveted together at a point which is very close indeed to the neutral axis. The concrete used by Messrs. Lindsay is called by them pumice concrete, as it is very light and tough, and it is a good material for constructing roofs, domes, etc.

You will perhaps have noticed that I alluded to the wrought-iron columns of the Phœnix Company. Until the completion of the Inner Circle of the Metropolitan Railway, I do not think wrought-iron columns were much used in this country, but I believe their use will rapidly extend. We have been told for a length of time that when columns are beyond a certain length in proportion to their diameter, they fail by bending and not by crushing, and we also know that wrought-iron is much stronger to resist tension than cast-iron, and as it is an undoubted fact that connections can be made to wrought-iron much better than to cast, we have here a combination of advantages where long columns have to be used which cannot but be appreciated, and which our American cousins are not slow to avail themselves of. Messrs. Lindsay have been on this tack for some time, and they have sent me here a section of their wrought-iron column, the strength of which is patent to all.

The use of steel for constructional purposes is increasing rapidly, as it is so much more reliable than iron, and Messrs. Lindsay roll many sections of steel which can very easily be formed into columns by riveting. The safe loads which such columns will sustain are very great. For instance, a column made of a series of steel troughs, such as I have described, the total external dimensions being sixteen inches, would bear a safe load of one hundred and fifteen tons if thirty feet long, and the weight would be seventy-four pounds per foot only. I have roughly calculated the weight, and the safe load on a cast-iron column sixteen inches in diameter, thirty feet long, one and one-half inches in thickness of metal; I find the weight would be two hundred and twenty pounds per foot run, and the safe load one hundred tons. I do not think the day is far distant when steel will have almost superseded iron for structural purposes.

Anything of the nature of fireproof material seems to me worth attention, and I will therefore briefly notice a substitute for wood lathing, either for partitions or ceilings, of which I have a model in the room. This consists of galvanized-iron netting, which is fixed by staples to hoop-iron slips, which are themselves secured edgewise to the studs or joists. The wire netting is then covered with plaster in the ordinary way. The wooden framework of the partition may be replaced by a construction of angle-iron, which takes up only half the space of an ordinary quarter or brick-nog partition, and this saving of space may sometimes be of considerable importance. The only thing that I am doubtful about is its permeability to sound, but, after all, ordinary partitions, or even brick party-walls, are, as many of us know to our sorrow, far from impervious to sound. I should say that a small structure formed by this iron lathing was severely tested about a year ago in Manchester, and the chief of the Fire Brigade reported very strongly in its favor.

Next to preserving the interiors of buildings from fire, one of the most difficult tasks is to preserve the exterior from the ravages of time and the weather, and it is, in fact, almost impossible to find a natural stone that will withstand the damaging effects of such an atmosphere as we have in London. In many parts of the country, too, beautiful old stone edifices are going rapidly to decay. The work of restoration of stone buildings is always difficult and expensive, but a means of doing this with comparative cheapness has been invented by M. Tabary, whose metallic cement has been extensively used on the Continent. This consists of a trachytic stone reduced to powder and then reunited by an acid without being decomposed. The material thus formed is permanent, and harder than the stone itself; it is not moulded, but carved to match any pattern, exactly like stone, and the surface and color can be made so precisely to resemble the original stone that the joint cannot be perceived. Mr. Blomfield and Professor Lewis made a careful examination of several buildings in France where restorations had been made in this metallic cement, and they reported most enthusiastically of it, and since then Mr. Blomfield has used it in many of his restorations in England. I cannot help thinking that this invention ought to prove of enormous value, because it will enable us at a small cost to stop decay of the stone at the outset. With stone itself one always has to wait till a sufficient mass of the stone can be removed, because of the difficulty of adding small pieces to what is left, but this difficulty is now entirely overcome.

Many gentlemen that were present a few weeks ago at the reading of Mr. Crossland's paper on the Holloway College must have been

much interested by the short notice which he gave of a system by which the pressure on the water-mains of a building could be very largely increased at will in the event of a fire breaking out. The instances have been numerous in which, although the fire-hydrants have been in perfect working order, considerable damage has been done through there being insufficient pressure to put out a fire before it has got beyond control. In London, the pressure in the fire-mains at the ground level averages from twenty-five pounds to thirty pounds per square inch, which is reduced one-half at a height of thirty-five feet from the ground, *i. e.*, the pressure diminishes as it becomes more urgently needed, because it is on the upper floors and at the roof of a building that water-supply would be most effective. In order to remedy this it has often been thought necessary in the case of important buildings to erect a large tank at the top of a building, or even to build a water-tower at considerable expense, and even where a head of water of one hundred and forty-four feet can be obtained, the pressure per square inch in the mains is only sixty-three pounds.

Now the system which I have alluded to is the invention of Mr. Vinning, and is called the High-pressure Fire-hydrant System. It consists in connecting with the ordinary mains one or more closed steel tanks charged with water, which can be at any moment submitted to any desired pressure up to one hundred pounds or one hundred and twenty pounds per square inch. This pressure is maintained by a series of wrought-iron cylinders filled with compressed air by means of a small air-pump or by other means, and kept permanently at the required pressure. These cylinders can be placed in any convenient position at a distance from the water-tank, and are connected together by small pipes so as to form practically one vessel, the bottom of which is connected by a small air-pipe, about three-quarters of an inch internal diameter, with the water-tank. The means for throwing the apparatus into use is a strong valve, which, when shut, confines the compressed air to the cylinders, but by turning the handle the valve is opened. At the base of the water-container, there is a large float ball-valve, which closes the access to the mains as soon as the water is discharged, and thus prevents the air entering these mains.

The water-container can be made of any required size, but for a large building it would probably be preferable to increase the number rather than the size of the containers. It is calculated that a vessel containing 2,000 gallons would give, with ordinary-sized pipes, a delivery of fifty gallons per minute for forty minutes, and, as the extinguishing power of water is much increased by very high pressure, this amount would generally suffice for the suppression of a large fire. Of course, after once going off, the air-cylinders require re-charging, but an air-pump is not absolutely indispensable, as steel bottles containing air at a pressure of over 1,500 pounds are now prepared, which can be carried about to any extent. Mr. Vinning is now engaged in putting up this apparatus at the South Kensington Museum, by order of the Science and Art Department.

While on the subject of water-pipes, I should like to call your attention to a very beautiful invention which, again, comes from the other side of the Atlantic. Everybody is familiar with the corrosive action of water on metal pipes, and in some cases, very serious effects upon health have resulted from the combination of certain chemical constituents in the water with the material of which the pipes were composed. But I have here some glass-lined pipes, than which nothing could be more cleanly, and they can be made to any bend that may be desired. These pipes have been patented for some few years, but there was found considerable difficulty in making the joints sound; this has, however, now been overcome, as the joints are all ground by an emery wheel, and special washers are used, and I think there ought to be a great future before this invention. In addition to these pipes being non-corrosive, it has been found practically that it requires a much more severe frost to congeal the water in these pipes than in ordinary metal ones. This is due partly to the packing and partly to the bad conducting power of the glass. These pipes can be jointed with much greater ease and speed than lead pipes, and when this is taken into account, their cost will be hardly any more than lead pipes. For breweries, acid works, and other places where ordinary pipes are soon destroyed, these glass-lined pipes will be most useful.

As land increases in value in London and other large cities, the tendency is to increase the height of all business premises, and thus gain more room. We see this in the new warehouses which are constantly being erected, but we do not go anything like so far in this direction as they do in the States, where buildings of ten stories are not uncommon. These high buildings would be comparatively useless without a very complete system of lifts, and the one to which I shall call your attention seems to me to combine, in a high degree, mechanical skill, ease in working, and safety. You are, of course, aware that elevators may be divided into two main classes, — those in which the cage is suspended, and those in which it is fixed at the top of a ram, which is generally worked by hydraulic machinery. Ordinary suspending tackle answers very well for goods-lifts, but there is considerable risk in relying upon it for passenger-lifts, even when provided with safety-catches, and, in fact, in many Continental cities, suspended passenger-lifts are absolutely forbidden. With hydraulic-ram lifts, of the usual construction, it was necessary to excavate a chamber for the ram of the full height of the working of the lift, and in the case of hard soils, such as rock, this would entail very great expense. One method of overcoming the difficulty was devised by Messrs. Stevens, who formed their ram in a series of cylinders, working one inside the other; but I am not able to state whether this principle has been found to answer well. The Otis elevator is a suspended lift, worked by hydraulic power, but the arrangements are such that I believe it to be absolutely safe. The cage is carried by four iron-wire ropes, which pass to a wrought-iron yoke, and then, dividing into two pairs, are carried down to two timber beams, upon which the frame of the cage stands. The wire-ropes pass over a guide pulley, and also over a loose pulley, and are fastened to a strong beam at the top of the building. The ropes are not connected directly with the cross-beams, but with a balanced lever-beam, to the action of which I shall refer again.

The framework of the cage carries gun-metal guides, which slide on each side of the timber uprights. The motive power is water, but no excavation for a ram is required, as the cylinder and piston which constitute the driving power can be fixed on the ground bed. By the intervention of the loose pulley just mentioned, the ascent or descent of the piston in the cylinder for any distance lowers or raises the cage just twice as much, and there would of course be no difficulty in increasing the mechanical advantage by the use of more pulleys. [The action of the lift was explained by means of diagrams.] Now, everything depends upon the safety appliances of such an elevator as this. The causes of danger are three: First, breaking of the supporting ropes; second, too rapid a descent in consequence of heavy weights; third, the counterweight carrying up a lightly-loaded cage higher than is intended, and thus breaking the connection with the flanges. The latter was the cause of the accident at the Grand Hotel, Paris. As the cage is in itself slightly heavier than the counterweight, the latter accident cannot happen; and even if it could, and the piston-rod were broken, the only tendency would be for the cage to fall rapidly, and this cannot occur. In case of the breaking of any one rope, the balance-beam is acted on, and a wedge-grip is brought into action on both sides of the lift. If all the ropes were to break, and the cage were to commence to hurry to the bottom, a second safety device is provided which comes into play as soon as a certain speed is attained, and this brings the wedges into play at once and stops the descent of the cage. As soon as these wedges have acted, they cannot be released except by raising the cage. I believe, however, that no case is known of all the ropes breaking. It is important to notice that the mere stretching of one of the ropes affects the balance-beam, and thus advertises itself to the attendant, who must at once see what is the matter with the ropes, and properly adjust them. I believe that experience has proved that the wire ropes made by the American Elevator Co. last, on the average, five years.

Another important point to be noticed is that this lift can be worked at a very low pressure, say forty pounds to the square inch, whereas other hydraulic elevators require a very high pressure, that would have been almost impossible to obtain a few years ago before the introduction of the hydraulic power system of high-pressure mains, where pressure up to seven hundred pounds per square inch can be obtained. This is not the place to enter upon a discussion as to the relative merits of low and high pressure, but no notice of modern inventions would be complete that did not include this most valuable system, — in the starting of which our late President, Mr. Whichcord, took very great interest, — by which hydraulic power can be laid-on to any building in London from a central station.

To turn to a very different subject, viz., heating, I should like to say a few words about a new stove which has come under my notice, and which I have lately introduced into one of my buildings. This is the invention of Mr. Lofts, of Cambridge, and acts upon the principle of giving as large an amount as possible of radiant heat, by compelling the smoke and heated air to take a circuitous course, warming a large surface of metal before it goes up the chimney. It thus differs from the majority of improved stoves which have been manufactured of late years, and which for the most part rely upon warming a large amount of air and causing it to enter the room. Several tests of this stove have been made, and its economical consumption of coal has been clearly established.

It has probably been the lot of some of us to have to design buildings for clients in whose eyes economy is a virtue far exceeding artistic effect, and I believe it is not an unknown proceeding to be obliged to go through the drawings and specification with a builder in order to reduce the estimate. I have known cases in which an architect has been at considerable trouble to design a staircase, and to put a little of what is known as "feeling" into his balusters, etc. These are precisely the features which a builder will pitch upon with the remark, "There's a lot of work in that staircase, sir; I can get some very nice turned balusters that will look quite as well as this, and not cost half so much," and your staircase looks just like any other speculating builder's. Some very great improvements have been made in turning machinery lately, and balusters and newels can be got now "square-turned." I confess I do not know how it is done, as I believe the machines are kept in jealous seclusion, but I have some specimens of square-turned balusters which will give you an idea of what is, at any rate, a little variety from the ordinary run. These have been kindly lent me by Messrs. Carter & Aynsley, of Bishopsgate Street. I must not be understood as in any way approving the design of these, but the fact that it is possible to turn things square was quite unknown to me a few months ago, and I thought it might be of interest to this meeting to know that such a thing is possible.

In connection with house-fittings I would call attention to Kaye's locks, several specimens of which are on the table. The simplicity of construction of these locks seems to me very commendable, and they have given great satisfaction in cases where I have used them. I would particularly call attention to an automatic cupboard lock.

Among decorative appliances I may mention Radeke's compressed wood pulp, which has been used to some considerable extent abroad, although it has not found its way at all largely in England. Some kind of composition is used as a basis, and is laid on a thin veneer of any kind of wood, such as oak, walnut, etc., and the whole is then compressed by hydraulic power into moulds, which can be made of any required design, except that it is impossible to have deeply under-cut mouldings. The grain of the wood is excellently preserved, and the effect of the finished product as a means of wall decoration is certainly good. I believe it can be treated in all respects as wood, viz., cut, sawn, or planed.

Artificial illumination is a subject that has attracted great attention during the last few years, and the threatened rivalry of electricity has given a strong impetus to the improvement of gas-burners, in order to obtain more perfect combustion. Among these I may mention the Albo-Carbon light, the Wenham lamp, Sugg's Cromarty burner, the Siemens regenerative gas-burner, and the Welsbach incandescent lamp, which latter consists in the combination with the gas-flame of a thin cylinder of some refractory substance which glows at a white heat. Although electricity has not ousted gas from the field, as it was at one time thought it would do, it has yet made more progress than many people imagine, and no architect would now think of designing a theatre, music-hall, hotel, or restaurant without fitting it with incandescent electric lamps, which do not give off as much heat as gas, and, — more important still, — do not contaminate the atmosphere. The invention of storage-batteries as a sort of buffer between the machine and the lights, and as a means of avoiding the risk of break-down of the engine, did much to render electric lighting more generally available, and considerable improvements have been made in these storage-batteries during the last few years. In the earlier forms of storage-battery, — for instance, the Faure-Sellon-Volckmar type, which is most largely in use, — there is always a certain amount of local action going on between the lead plates; but in the battery of the Union Electrical-Power Light Co., which they have been kind enough to lend me to-night, there is no local action at all. The elements consist of solid slabs of peroxide of lead and plates of spongy lead, and are immersed in dilute sulphuric acid. The peculiarity of the peroxide plates is that the material used in its construction causes it to set into a perfectly hard and durable form, so that it is not injured by transport. The size of the plates is seven inches by four inches, and the total weight of the cell complete in a case is twenty pounds eleven ounces only. This lightness is achieved partly by the plates being loosely held by strips of celluloid, which material is also used to cover the strips of platinum by which contact is made. The elements are connected together by platinum wires dipping into small wells of mercury. Professor Forbes made some very careful tests of one cell of this battery, and obtained a discharge of about eight-and-a-half ampères for nearly fourteen hours. He also reported that the efficiency of the cell was between eighty and ninety per cent. The cells are contained in small wooden boxes, which are readily transported from place to place. When the elements are exhausted fresh ones can be supplied, and the old ones recharged, but spare plates can always be kept ready for use at any time. A battery of fifteen cells will run twelve ten-candle incandescent lamps, and occupies a few feet only. The recharging of the plates must of course be done by a dynamo machine.

While on this subject, I must mention a small primary battery and lamp combined, which will enable any one to have an electric lamp on his table at any time, and which can be recharged by simply pouring into the cell containing the plates the necessary liquid. These lamps are made in very ornamental cases, and one of the size here will run about three hours, *i. e.*, during the continuance of dinner; but if a larger size were adopted, they would, of course, last longer.

I now come to a subject which cannot be called in any sense an invention, but it is a discovery of very great importance as affecting the strength of materials, and although it affects engineers more than architects, I think we ought to be acquainted with its main features. For a considerable period it was considered sufficient to ascertain, with more or less exactness, the ultimate tensile or compressive strength of a timber beam or an iron bar, or any such material subjected to stresses or strains, and then to take a certain factor of this ultimate strength as a fairly safe working strength. But so long ago as 1870 a German engineer named Wöhler, made a very large number of experiments which showed conclusively that the breaking strength of any material depends not so much on the statical load, but on the *extreme variations* of load which the p ece has to undergo. For instance, taking 45,000 per square inch as the average breaking tensile strength of wrought-iron, a rod which would be subjected to a steady load of 90,000 pounds ought to have a sectional area of eight square inches, using a factor-of-safety of one-fourth; but if, instead of the steady load, the rod would be subject to alternate changes of load varying from 10,000 to 90,000 pounds, its sectional area would have to be eleven and one-fourth square inches. If the same rod were subjected to alternate compression and tension it would require to be even stronger. Wöhler expresses this law as follows: The fracture of a material can be effected by variations of stress repeated a great number of times, none of which reaches the breaking limit, the difference between the extreme stresses determining the breaking strength. Wöhler's experiments were purely empirical, and their results have considerably exercised the minds of scientific men, but another German, Professor Bauschinger, of the Munich Polytechnic School, has been carrying on for several years a most exhaustive series of experiments, the result of which are published in a series of memoirs to which Professor Unwin was kind enough to call my attention, and of which he has published a short *résumé*. The puzzling anomaly of Wöhler's experiments lay in the fact that when subjected to alternate tension and compression a bar broke down at a stress lower than its elastic limit, and Bauschinger thinks he has discovered the explanation to be that in many materials the elastic limit has been raised artificially in the process of manufacture. I have not time to pursue this question further, but one illustration will show how it may effect our work. In an iron roof of ordinary construction, in which the pressure on one of the struts under ordinary circumstances is 1,500 pounds, a heavy gale of wind would just double this, and this variation of pressure would reduce the ultimate strength of the strut nearly twenty per cent.

Professor Bauschinger has also carried out a large number of most careful and elaborate experiments on the behavior of full-size cast-iron columns and wrought-iron stanchions, under the influence of heat and sudden cooling, and he found that cast-iron did not warp so much as wrought, but that if cast-iron was heated to a certain point and then had a stream of water directed on it it bent so much that it broke in two. He has also experimented on piers of stone and concrete, and comes to the following general conclusions: First, that no natural stone will withstand fire, but that granite did so the best; second, that brickwork behaved much better than any stone; and third, Portland cement concrete was best of all. It is impossible to give any idea of the exhaustive and minute character of Professor Bauschinger's experiments, and he is, I believe, still continuing them, and their results must have a very important bearing upon our knowledge of the strength of materials.

The experiments from which the formulæ for the strength of timber beams, joists, etc., were deduced, were in almost all cases made on very small pieces, and it has been a pure assumption that larg pieces would behave in the same way. During the last few years a number of experiments have been made in the States, chiefly by Mr. Lanza at the Massachusetts Institute of Technology, on full-size pieces of timber; the results show that our ordinary formulæ require considerable revision. For instance, a spruce beam twelve inches by two inches by fifteen feet long, broke with a central load of 5,894 pounds. According to Tredgold's formula, it ought to have supported a load of 8,928 pounds before breaking. This result was corroborated by other tests, and the general conclusion arrived at is, that whereas we have been accustomed to use as a constant in the familiar formula $W = \frac{cb\,d^2}{l}$ four hundred-weights for fir or pine beams, — in fact, in one of Tredgold's examples 530 pounds is used, — we ought really to use a constant of not more than two-and-a-half hundred-weight. The more thoroughly large-size specimens, whether of wood or iron, are tested the more will our knowledge of their strength be increased, and we shall be less dependent upon theory.

In conclusion, I will only say that one most important discovery has been made in the last few years to which I have not yet alluded, and that is that one necessity for an architect is a thorough education, and the result of this discovery must have very far-reaching effects on our profession.

COMMUNICATIONS

TRINIDAD ASPHALT.

ALBANY, May 16, 1887.

TO THE EDITORS OF THE AMERICAN ARCHITECT: —

Dear Sirs, — Will Trinidad asphalt, placed on the exterior of stone-walls underground for a damp-proof course, decay?

Yours truly, F. H. J.

NOTES AND CLIPPINGS

AN AQUARIUM *au naturel* — Mention has been made in the newspapers from time to time of an aquarium that Mr. Adolph Sutro intended to build out upon the ocean-beach near the Cliff House. Those who have been out to the Cliff House and have descended the steps that lead to the beach will doubtless have noticed a little cove sheltered between two high rocks about 100 feet from the steps. In this cove the aquarium is now being built. The aquarium will consist of a round wall of rock 50 feet in diameter, 15 feet thick, and 14 feet high, and will be roofless. The flooring will be made in a unique way, according to Mr. Sutro's plans. Solid pathways of rock will be built around the interior of the aquarium, and between them there will be little ponds of water that will be 3 and 4 feet deep at low water. The water will come into these ponds from the ocean with fish and other marine objects in the following manner: A tunnel 300 feet long and 8 feet high will be bored through the rock between the ocean and the aquarium, and at the seaward side of the tunnel there will be wire-screen gates, which

can be opened and shut. At high tide the gates will be suffered to remain open, so that the water and the living objects in it can come freely into the aquarium. At high water the whole aquarium will be flooded — the pathways and everything — and no one can go in then. When the tide begins to recede *the gates* are shut, and *only the water* can flow *through* them. The living objects will be retarded, and will seek the comparatively deep water in the ponds, and thus they will be caught as in a trap. When the waters have receded sufficiently from the pathways the public will be admitted inside the walls. Sea-anemones, devil-fish, angel-fish, star-fish, crustaceans, shells, all varieties of large and small fish, and, perhaps, even occasional seals may be caught in this aquarium. At low tide there will always be something interesting to see there.— *San Francisco Call.*

Discoveries at Ancient Sidon. — Only a few weeks have elapsed since the world of archæology was highly interested by the news of a most-important archæological "find" in the neighborhood of the ancient Sidon. The discovery was made by Mr. Eddy, an American missionary, who resides at Saida. In a garden adjacent to the town he discovered a shaft which, on being explored was found to communicate with a rock-cut temple or tomb, containing several sarcophagi of Græco-Phœnician work. One of these with friezes, representing warlike combats and hunting scenes, was said by an archæologist who examined it to be one of the most magnificent specimens of art ever discovered. The Turks refused to allow photographs to be taken or to admit any Franks to the tomb, and, to the regret of science, news has just reached this country that this priceless work of art, together with several statues, have been broken to pieces, and that heads, arms, and other fragments are being offered for sale in the bazaars. — *Manchester Guardian.*

A Water-main struck by Lightning. — A correspondent of *Fire and Water*, writing from New Britain, Conn., sends the following account of the fracturing of a water-main by lightning: "During the heavy thunder-storm of February 18, the lightning, in addition to burning out a coil on the fire-alarm circuit, thus disabling the alarm for about an hour, also did considerable damage to the water-main on John Street. Closely following a very heavy flash of lightning, people in the act of drawing water from their faucets heard a cracking sound. One woman, who had her hand on the faucet, received quite an electric shock, and the water ceased running. On investigation, it was discovered that the 4-inch cement-lined water-main had burst in a number of places. Up to this time there have been found ten different breaks in the main, within a distance of 300 yards. All the breaks are on the top of the pipe, as if it had been struck with a heavy tool of some kind. Such a freak of lightning has never occurred in this city before. The bolt is supposed to have run down inside of the jacket of a fire-hydrant close to one of the breaks."

A Real Weeping Tree. — On my way to and from the Mussoorie Library I have noticed for some days a small pool of water in the middle of the road just above "Auchnagie." It struck me as being something singular; and to-day, when passing, I noticed several drops of water fall into it; on looking up I saw that it was the sap from a branch high up on a tree that was falling into it; the drops were large, and were falling at the rate of one a second. I afterwards noticed several other trees of the same kind on the roadside dropping sap from their branches in the same way. The tree is a large one, called by the natives Kagashi (*Cornus macrophylla?*). In the spring, if the bark of this tree is wounded by an axe, the sap runs out of the wound in a great stream; some of it solidifies into a thick mucilage of a bright orange color; it was from a broken branch that the sap was coming, broken, most likely, by the heavy fall of snow we had at the end of January. These trees are just bursting into leaf, but they have been weeping for the last ten days at least. — *A. C., in the Indian Forester.*

The "Jubilee" Service at Westminster Abbey. — It is to be regretted that the discussion upon the £17,000 to be expended on the Westminster Abbey jubilee service came on so late that the report had to be condensed in the daily papers, for a more profligate expenditure never has been permitted. The abbey is to be converted into a sort of Olympia, with great wooden galleries. The wood, which is only to be hired for a day, is to cost £9,000. It consists of battens, most of which will be as valuable after the ceremony as before. The galleries are to be covered with some sort of hangings, and cushions are to be provided. The loan of the hangings and cushions is to cost £5,500. Stationery is to cost £1,100, though what this stationery is to consist of no one knows. In addition to this the dean and chapter are to receive £500 for possible damage to the cathedral, and £300 as a *solatium* for not being able to hold ordinary services while the galleries are being erected. Mr. Plunkett estimates that galleries will seat 10,000 persons, therefore the seating will cost £1 4*s.* per head, whilst churches are entirely built at an average cost of £2 per head. But a most curious admission was made by Mr. Plunkett during debate. He said that Conservative supporters of the government had informed him that they would not vote for the expenditure unless their wives were given seats. These wives are, no doubt, very excellent and very charming persons, but they are expensive. We have it on the authority of Mr. Plunkett that had he not consented to their demand for seats their husbands would not have agreed to the estimate, so excessive do they deem it. — *H. Labouchere.*

Alexander the Great and Petroleum. — Many ancient authors mention petroleum, either in the form of crude oil for burning or as bitumen. The most interesting reference, however, to petroleum in the form of oil, is in Plutarch's "Life of Alexander the Great," where it is stated that in the district of Ecbatana (probably the modern Hamadan in Persia) "Alexander was particularly struck with a gulf of fire, which streamed continually as from an inexhaustible source. He admired also a flood of naptha not far from the gulf, which flowed in such abundance that it formed a lake. This naptha, in many respects, resembles bitumen, but it is much more inflammable. Before any fire touches it, it catches light from a flame at some distance, and often kindles all the intermediate air; the barbarians, to show the king its force and the subtlety of its nature, scattered some drops of it in the street which led to his lodgings; and, standing at one end, they applied their *torches, for it* was dark, to some of the nearest drops; the flame communicated itself swifter than thought, and *the street* was instantaneously all on fire." We also find recorded in Plutarch the very sad consequence of a practical joke played with petroleum for Alexander's amusement. "There was an Athenian who, among others, waited on Alexander when he bathed, and anointed him with oil; this man had the greatest success in his attempts to divert him. One day a stupid-looking boy, named Stephen, happening to attend at the bath, the Athenian said to the king, 'shall we make an experiment of the naptha upon Stephen? if it takes fire even upon him, and does not presently die out, we must indeed allow its force to be extraordinary!' The boy consented to undergo the trial; but as soon as he was anointed his whole body broke out into a flame, and Alexander was extremely concerned at his danger. Nothing could have prevented his being entirely consumed by it if there had not been people at hand with many vessels of water for the service of the bath. As it was, they found it difficult to extinguish the fire, and the poor boy felt the bad effects of it as long as he lived." We must, in this case, suppose that a light was applied to the boy, after being anointed with oil, or else that he was in the immediate vicinity of a large fire used for heating the bath. — *Murray's Magazine.*

TRADE SURVEYS

Nothing has occurred during the week in commercial or financial circles to weaken confidence or depress prices. The mass of railway and financial statistics furnished each week exhibit growing strength and activity. The industrial conditions are favorable. Work is abundant. Wages are advancing in some crafts because of the active demand for special skill. The output of furnaces, mills, and factories has been subject to scarcely any control. The go-as-you-please race for trade is stimulating enterprise. Financiers are offered their pick and choice of opportunities. Industrial managers do not discern the outlines of trade-disaster on the horizon. Demand is surprising the conservative. Production is galloping at feverish pace, but accumulation has not set in. Trades people are cautious and purchase only for visible demands. Shop and factory owners are pretending to gauge production to market demands, but could increase their output very little at best. Bankers are rather seeking borrowers throughout the interior. Merchants and jobbers are distributing merchandise to their satisfaction. Labor agitations are confined within narrow limits. Employers are now flocking together in spirit and fact as never before. The always-present germs of disruption are directing the attention of labor leaders to internal differences and elements of disruption rather than to outer objects. The volume of business for the week is larger than for the week previous. The expected anticipation of summer requirements has not yet set in in the heavier industries. In textiles, hosiery, and knit-goods manufacturers have placed the bulk of their output for the fall; in woollens and worsteds restriction is observable; in cottons activity has not been arrested. In hardware New England manufacturers have enjoyed a busy season, and the probable consumption has been carefully calculated. Barbed wire is declining. Implements for farm work are offered at a moderate discount. The demand for motive power for shop, river, lake, and coastwise crafts has greatly improved, and this branch of industrial activity will, for the next twelve months, absorb increased material and labor. Water-ways will be more largely used in the future both North and South, especially as the smaller industries multiply in the Ohio and Mississippi valleys. Though the volume of traffic can never reach the enormous railroad volume, yet the tendency now is towards a multiplication of water traffic, and this will greatly increase the demand for all subordinate appliances. The architects in all large cities continue to report a rush of work. Their services are more widely sought for ordinary work which, in recent years, was done by builders by rule-of-thumb. The architects have forced a recognition of their services and are putting strong foundations under their profession. There is a marked increase in the number of office-buildings and of banks. Railroad companies are about expending large sums of money to complete terminal facilities and office conveniences. Church work is quite abundant, and architects are giving church architecture closer study, and are escaping from some of the old ruts. Suburban building activity is general in all large cities, and there is a remarkable activity in lot selling and in alteration of old houses and stores for modern uses. In fact, many of the older Eastern cities show that a rapid transformation is in progress. City residents are surrendering homesteads, and suburban places are receiving new accessions. During the coming six months, it is said, on good authority, that a dozen or more cities will be furnished with electric street-car lines. The hesitancy shown to the adoption of one of the many systems is due to the fear of investors that something better or cheaper will be found. The iron and steel makers are crowding every furnace and roll, but feel anxious to book summer business which conservative buyers are holding back. There is an overproduction of nails which can hardly be prevented. Merchant-iron is next weakest on the list; plates and sheets third. Crude iron is strong under the extraordinary output of 20,000 tons per day. Bridge iron comes next to steel rails in strength and activity. The lumber manufacturers and dealers indulge in their chronic complaint about business, but their only trouble is to get lumber fast enough to fill orders. The receipts of white and yellow pine and of hardwoods while heavy are no greater than needed. Hemlock is very active in Pennsylvania, poplar in West Virginia, and walnut in Tennessee. New sources of supply are coming within reach of water and rail. The coal trade is once more improving in trade parlance, but it has never been weak. In anthracite the production is one million tons ahead of the production at this date last year, and a restriction is now on which will reduce the supplies three quarters of a million tons. Buyers have begun to run-in their orders. The locomotive-builders anticipate quite an increase in orders. With all the activity in railroad-supply establishments the minimum of motive-power and rolling-stock is at work. Whatever of conservatism is shown by consumers is due to the possibility of a reaction in a year or two which will create a tumble in values of material and labor. Buyers of products which are to last many years will hesitate to fill their maximum requirements on a rising market. But neither markets nor trade are controlled by the pretended foresight of individuals, or any number of them. The country seems to be blindly stumbling headlong into prosperity, and unexpected markets are opening up on all sides.